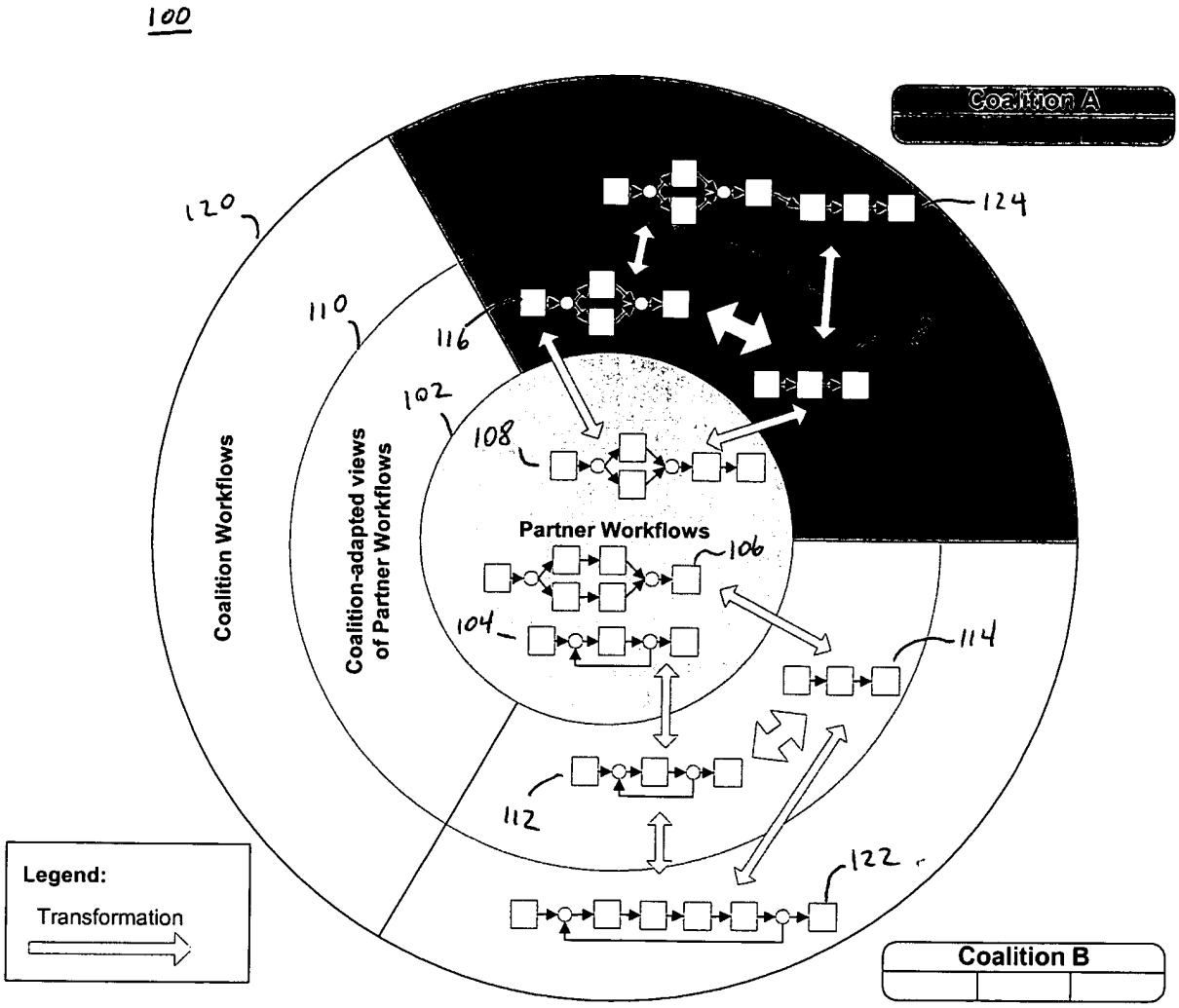

100
Coalition A
120
124
110
116
102
108
Coalition Workflows
Coalition-adapted views of Partner Workflows
Partner Workflows
106
104
114
112
122
Legend:
Transformation
Coalition B

FIG. 1

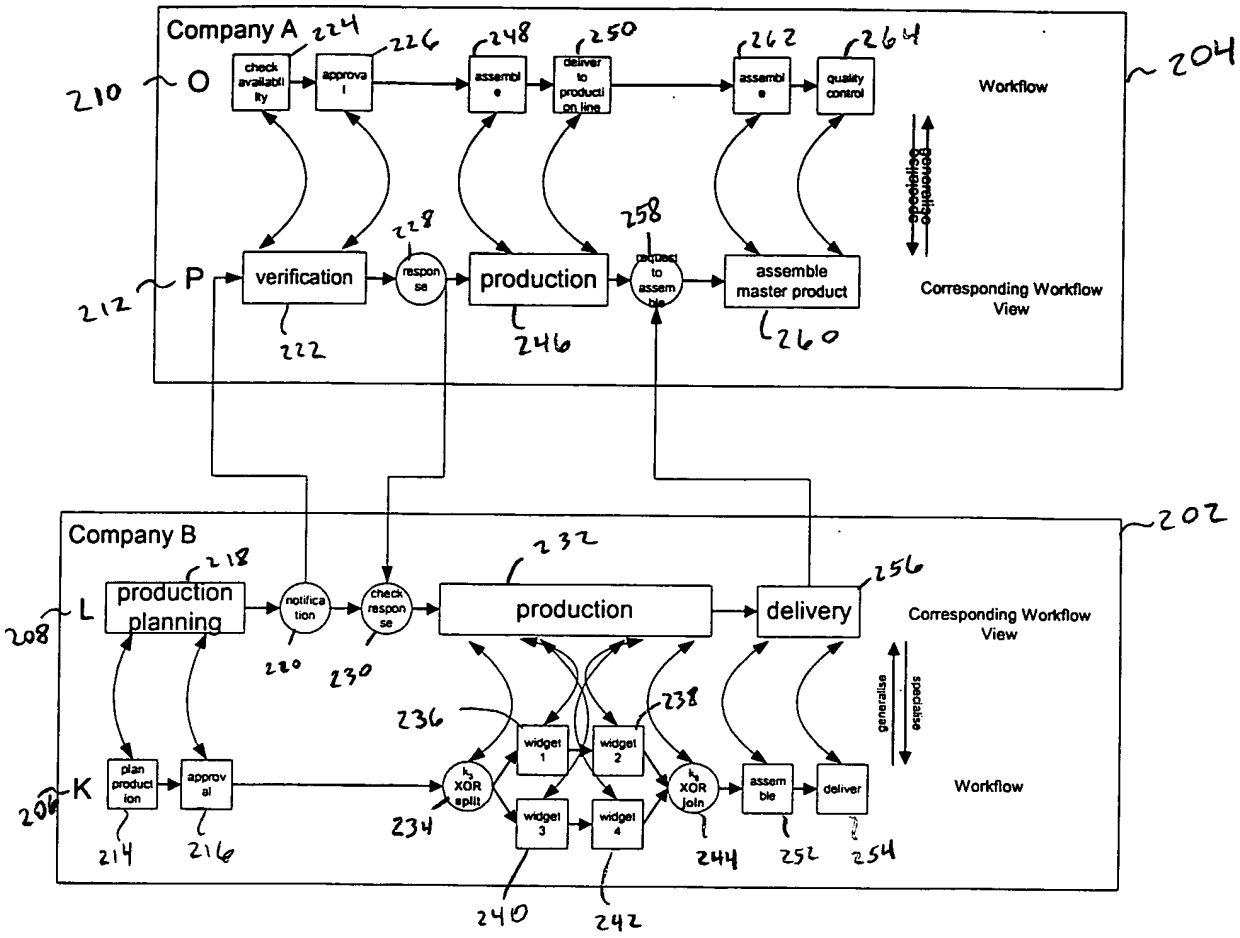

Company A
check availabli lity
approva l
assembl e
deliver to producti on line
assembl e
quality control
Workflow
generalise
specialise
O
P
verification
respon se
production
assemble master product
Corresponding Workflow View
Company B
production planning
notifica tion
check respon se
production
delivery
Corresponding Workflow View
L
K
plan product ion
approv al
XOR split
widget 1
widget 2
widget 3
widget 4
XOR join
assem ble
deliver
Workflow

FIG. 2

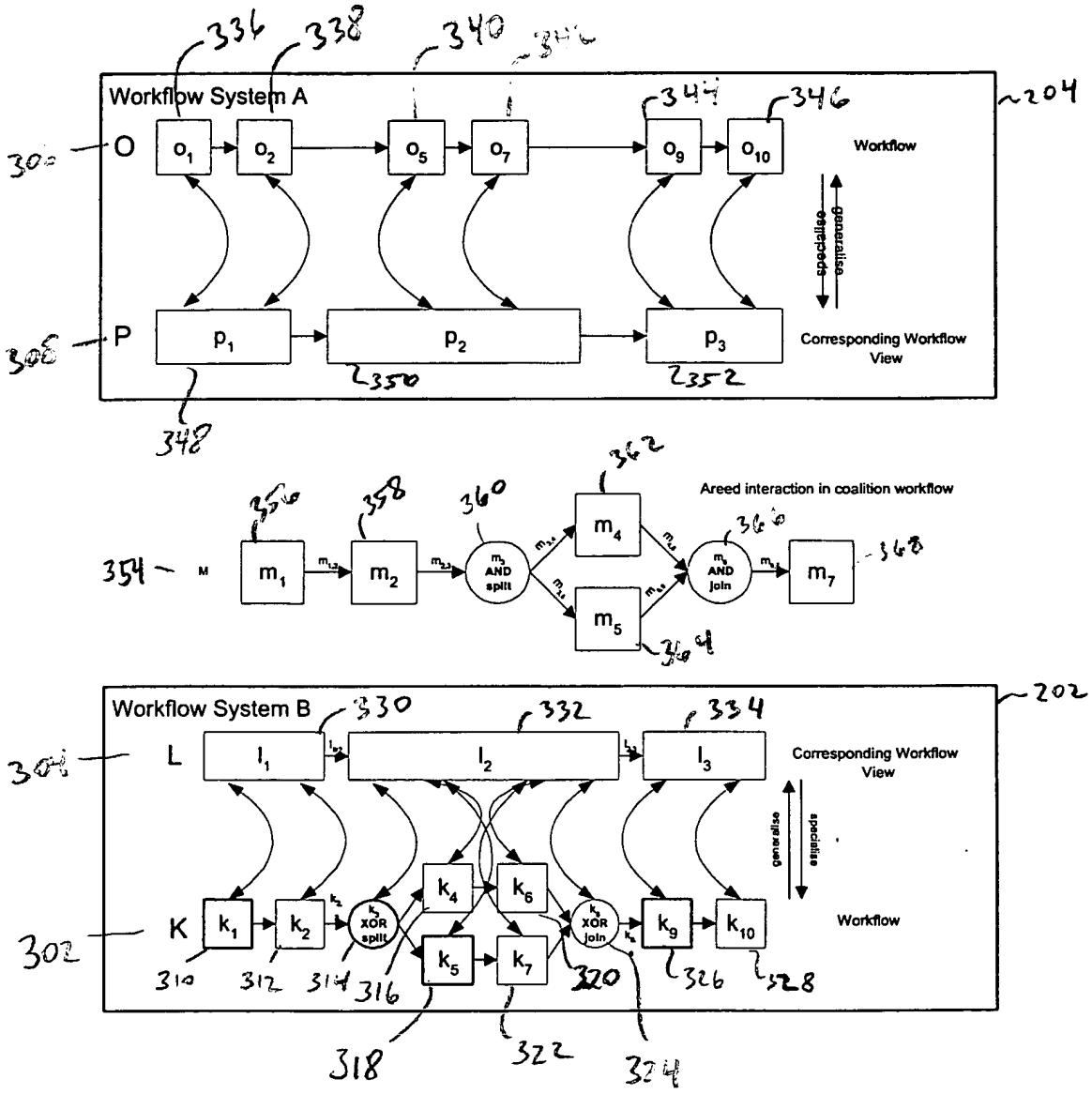

Workflow System A
O
P
Workflow
Corresponding Workflow View
specialise
generalise
Areed interaction in coalition workflow
M
AND split
AND join
Workflow System B
L
K
XOR split
XOR join
Corresponding Workflow View
Workflow

FIG. 3

400

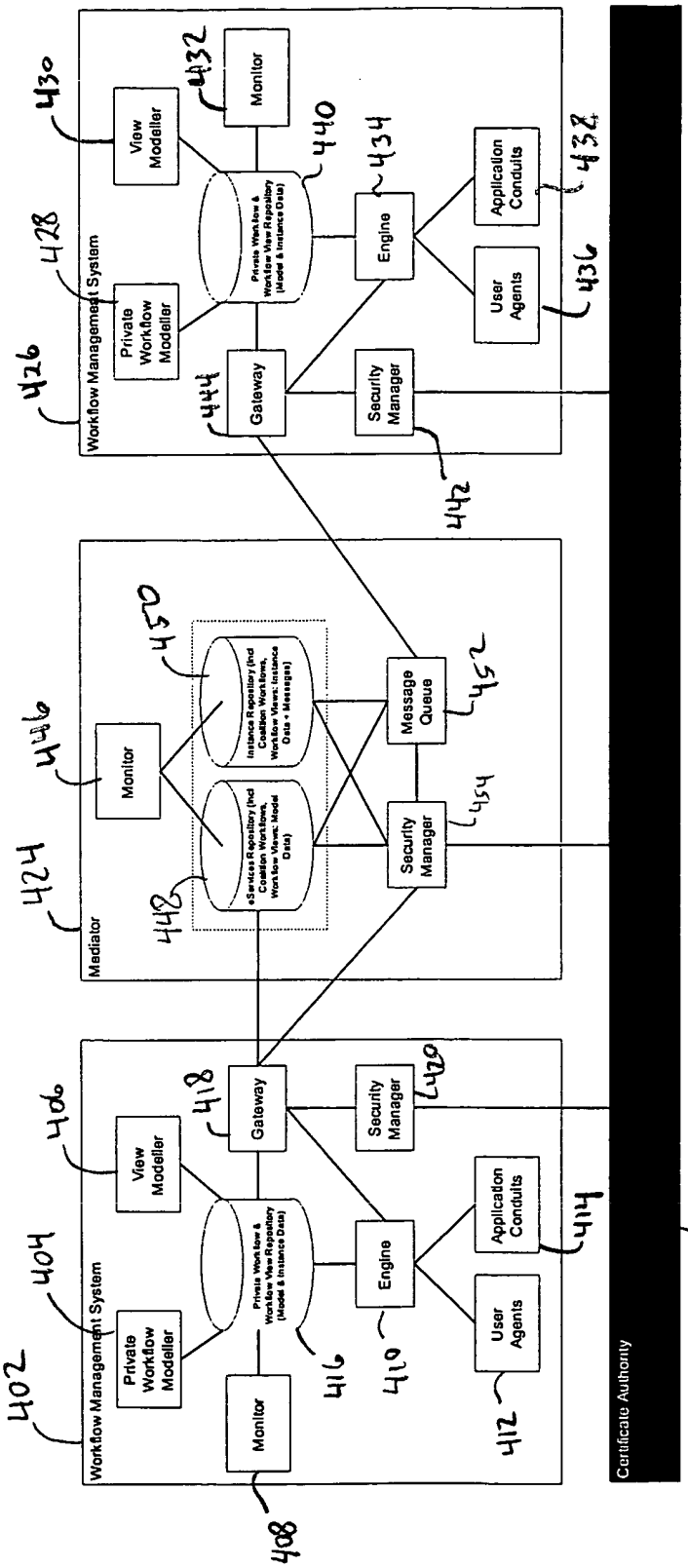

Workflow Management System
Private Workflow Modeller
View Modeller
Monitor
Private Workflow & Workflow View Repository (Model & Instance Data)
Gateway
Engine
Security Manager
Application Conduits
User Agents
Mediator
Monitor
Message Queue
Security Manager
Instance Repository (Incl Coalition Workflows, Workflow Views, Instance Data + Messages)
eService Repository (Incl Coalition Workflows, Workflow Views, Model Data)
Workflow Management System
Private Workflow Modeller
View Modeller
Monitor
Private Workflow & Workflow View Repository (Model & Instance Data)
Gateway
Engine
Security Manager
Application Conduits
User Agents
Certificate Authority
402
404
406
408
410
412
414
416
418
420
422
424
426
428
430
432
434
436
438
440
442
444
446
448
450
452
454

FIG. 4

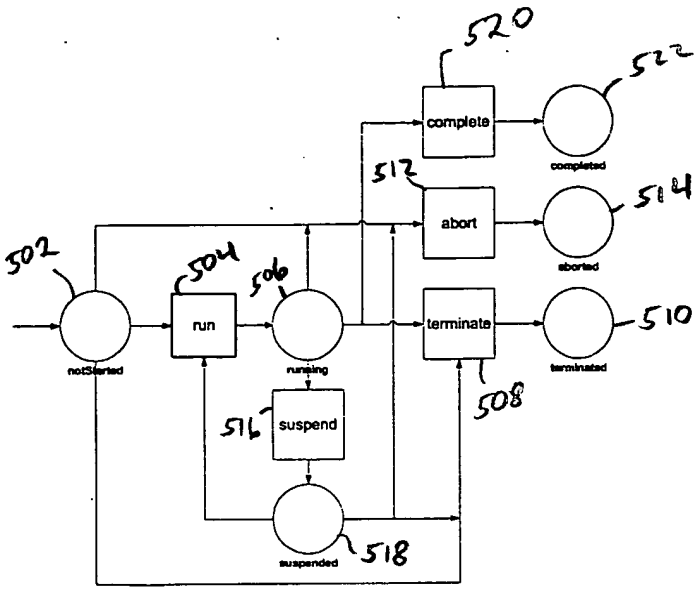

520
522
complete
completed
512
abort
514
aborted
502
504
506
run
terminate
510
notStarted
running
terminated
508
516
suspend
suspended
518

FIG. 5

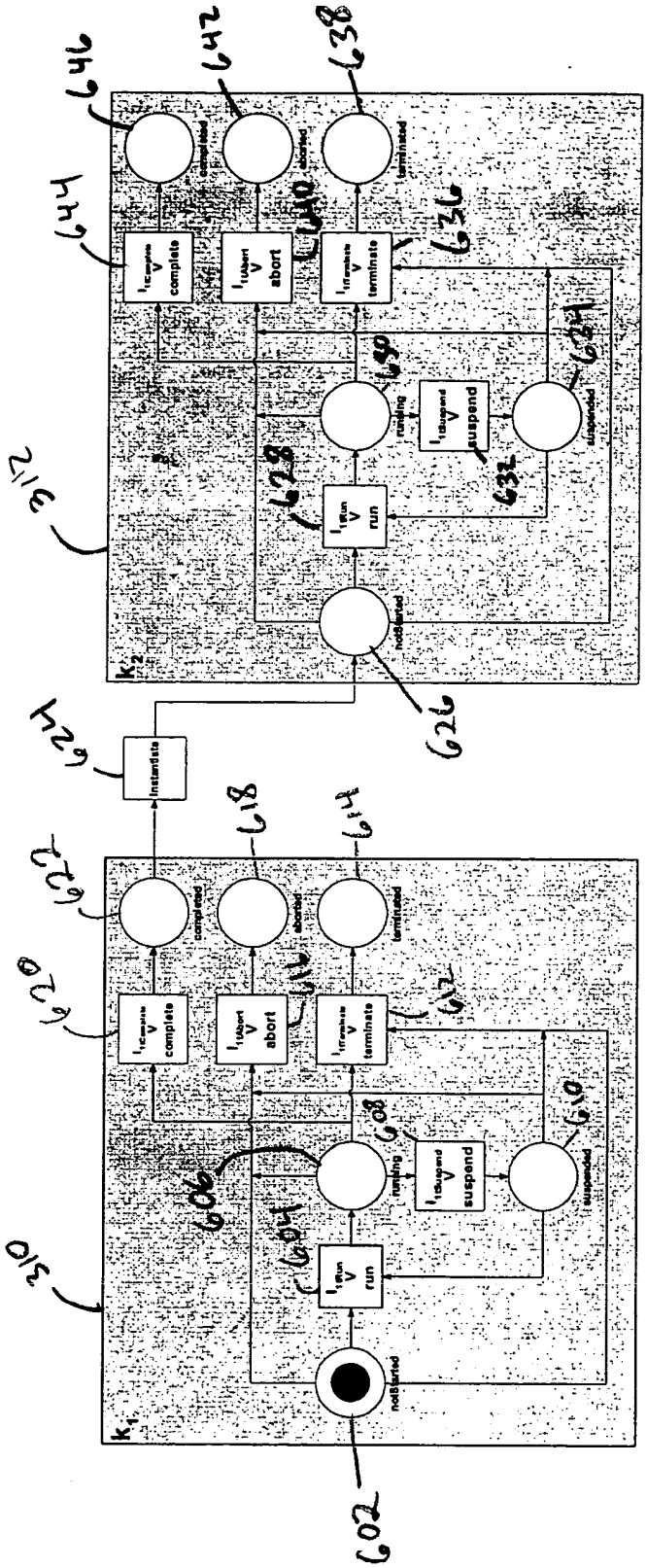

completed
aborted
terminated
complete
abort
terminate
running
suspend
suspended
run
notStarted
instantiate

FIG. 6

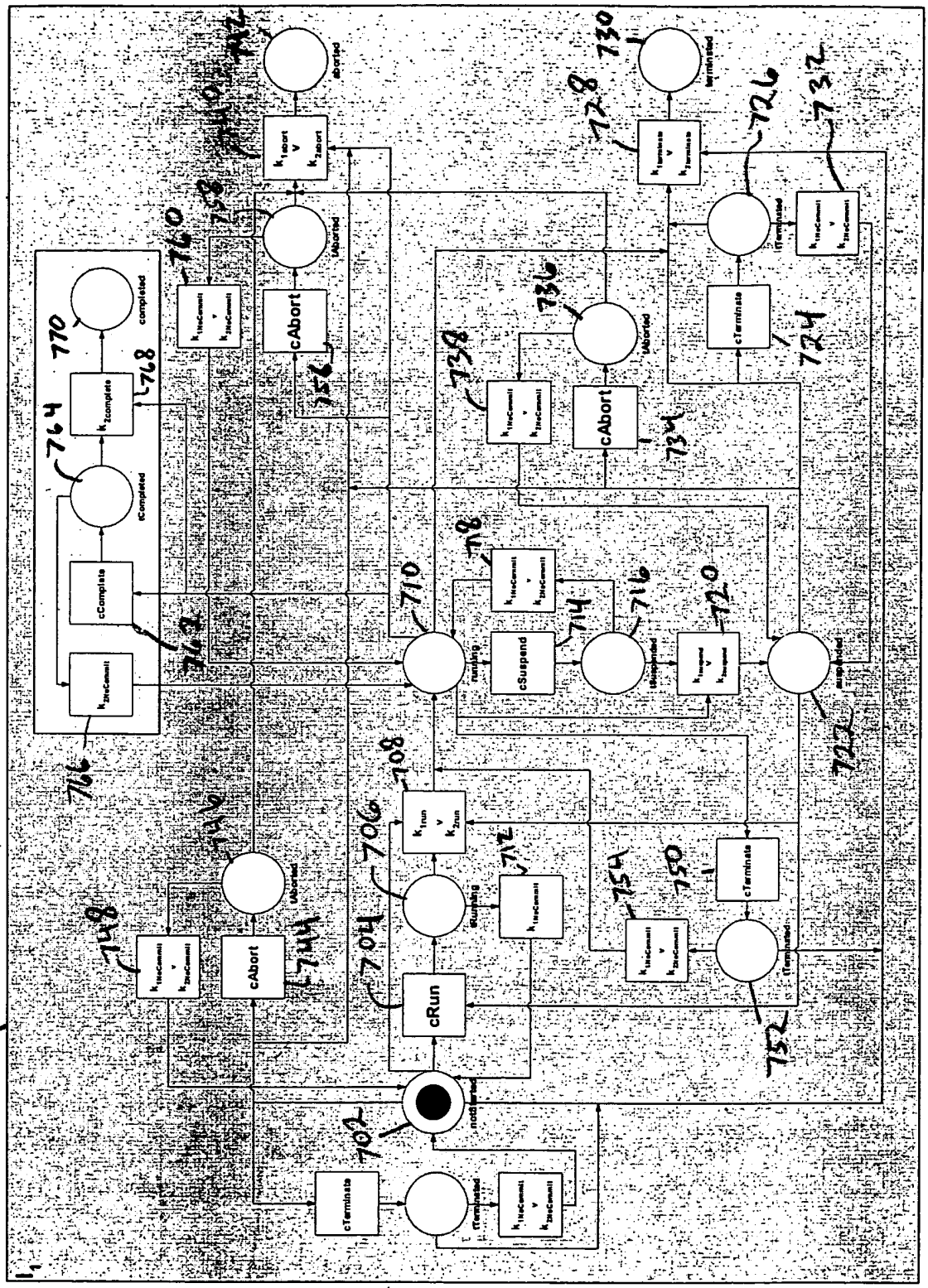

230
702
704
706
708
710
712
714
716
718
720
722
724
726
728
730
732
734
736
738
740
742
744
746
748
750
752
754
756
758
760
762
764
766
768
770
cRun
cSuspend
cAbort
cTerminate
cComplete
cResume
running
suspended
aborted
terminated
completed

FIG. 7

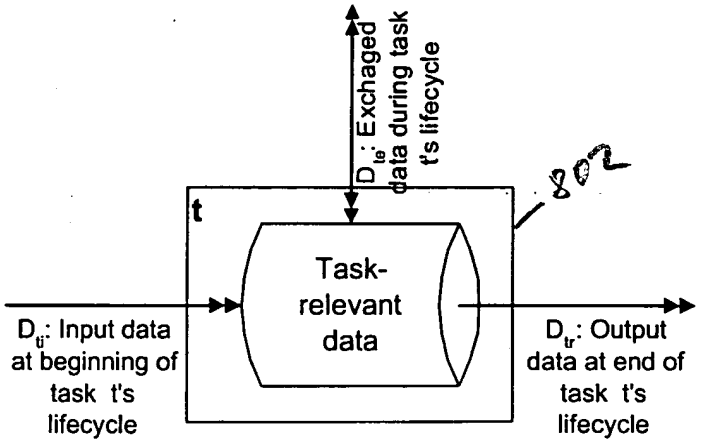

D_{ie}: Exchaged data during task t's lifecycle
802
t
Task-relevant data
D_{ti}: Input data at beginning of task t's lifecycle
D_{tr}: Output data at end of task t's lifecycle

FIG. 8

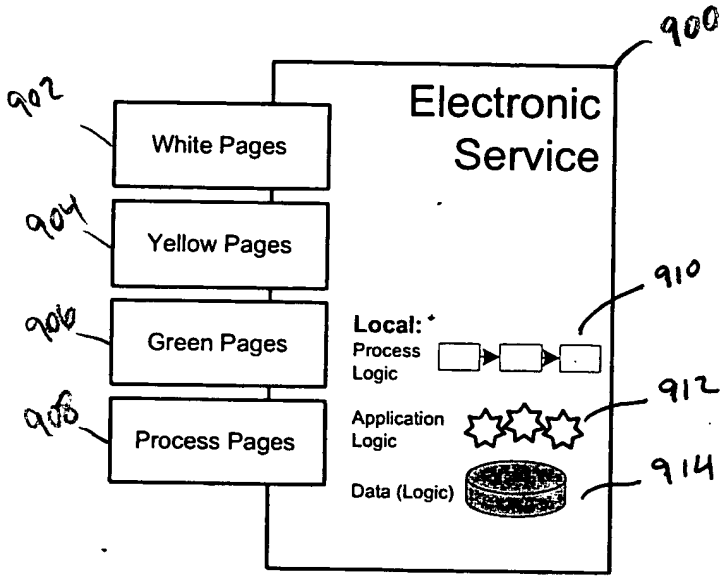

900
902
White Pages
904
Yellow Pages
906
Green Pages
908
Process Pages
Electronic Service
910
Local:
Process Logic
912
Application Logic
914
Data (Logic)

FIG. 9

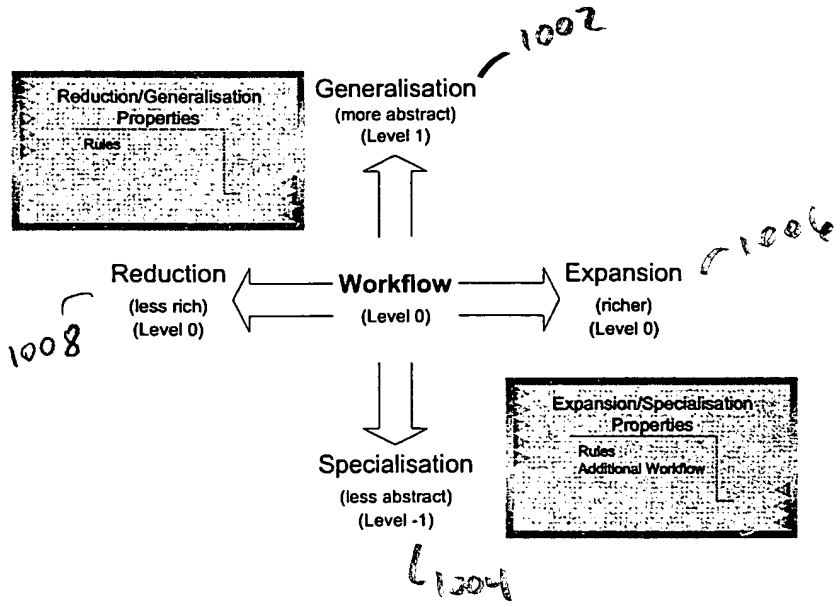

1002
Reduction/Generalisation Properties
Rules
Generalisation
(more abstract)
(Level 1)
1006
Reduction
(less rich)
(Level 0)
1008
Workflow
(Level 0)
Expansion
(richer)
(Level 0)
Expansion/Specialisation Properties
Rules
Additional Workflow
Specialisation
(less abstract)
(Level -1)
1004

FIG. 10

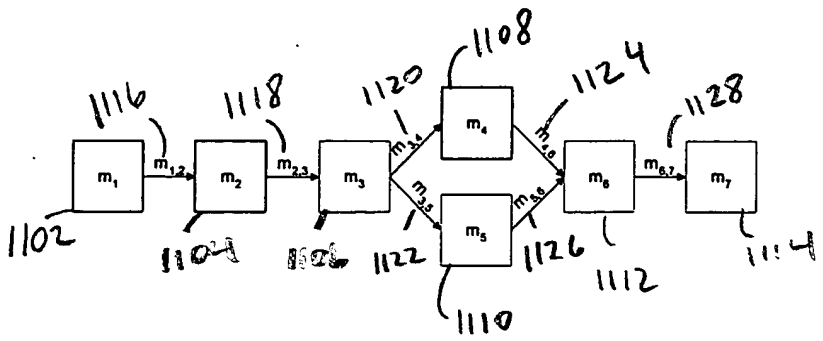

1100
1116
1118
1120
1108
1124
1128
m_1
$m_{1,2}$
m_2
$m_{2,3}$
m_3
$m_{3,4}$
m_4
$m_{4,6}$
$m_{3,5}$
m_5
$m_{5,6}$
m_6
$m_{6,7}$
m_7
1102
1104
1106
1122
1126
1112
1114
1110

FIG. 11

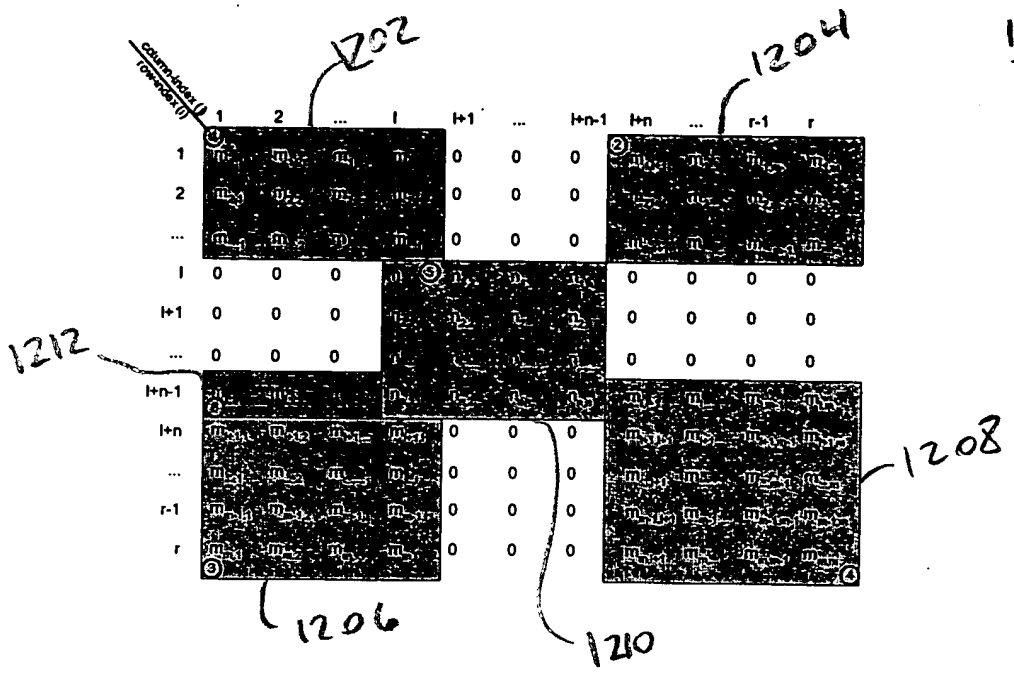

1200
1202
1204
1212
1208
1206
1210
column index (j)
row index (i)
1
2
...
l
l+1
...
l+n-1
l+n
...
r-1
r

FIG. 12

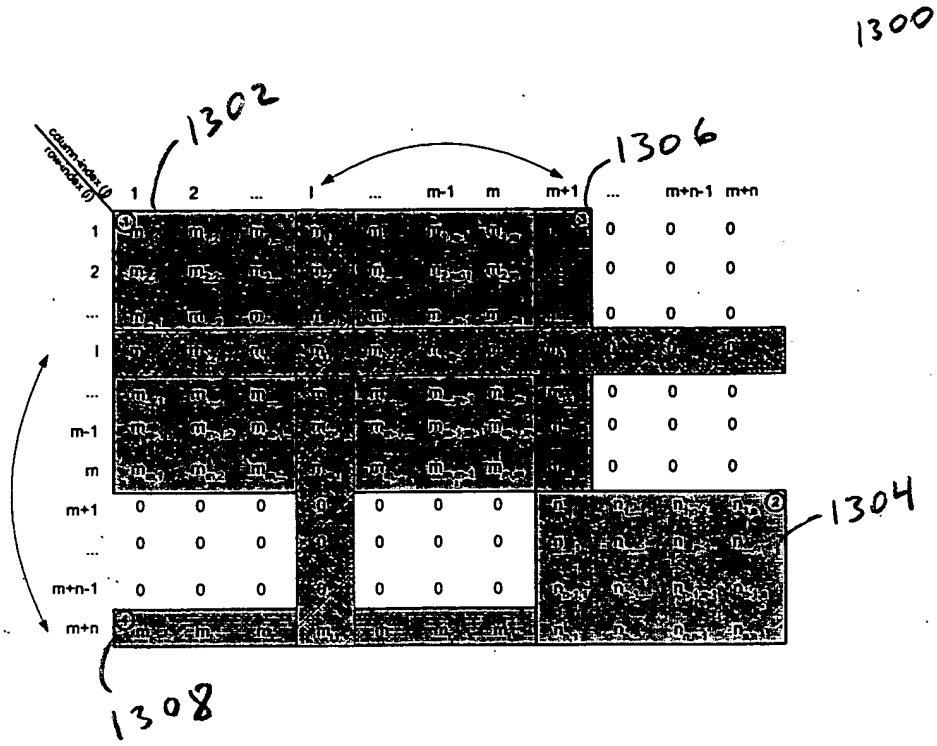

1300
1302
1306
1304
1308
column index (j)
row index (i)
1
2
...
l
...
m-1
m
m+1
...
m+n-1
m+n
0

FIG. 13

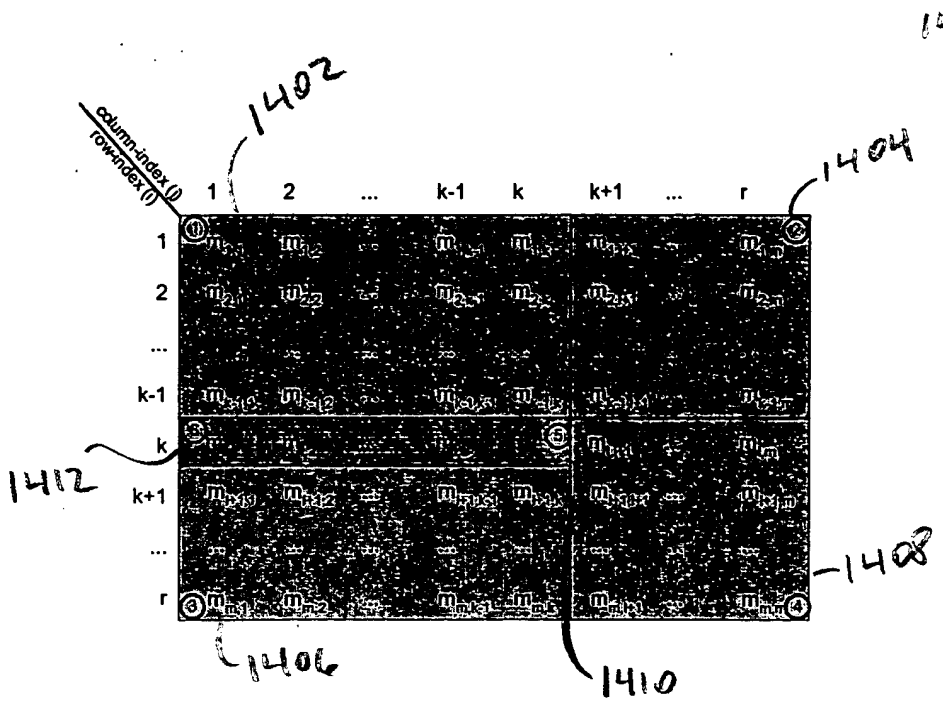

1400
1402
column-index (j)
row-index (i)
1
2
...
k-1
k
k+1
...
r
1404
1412
1408
1406
1410

FIG. 14

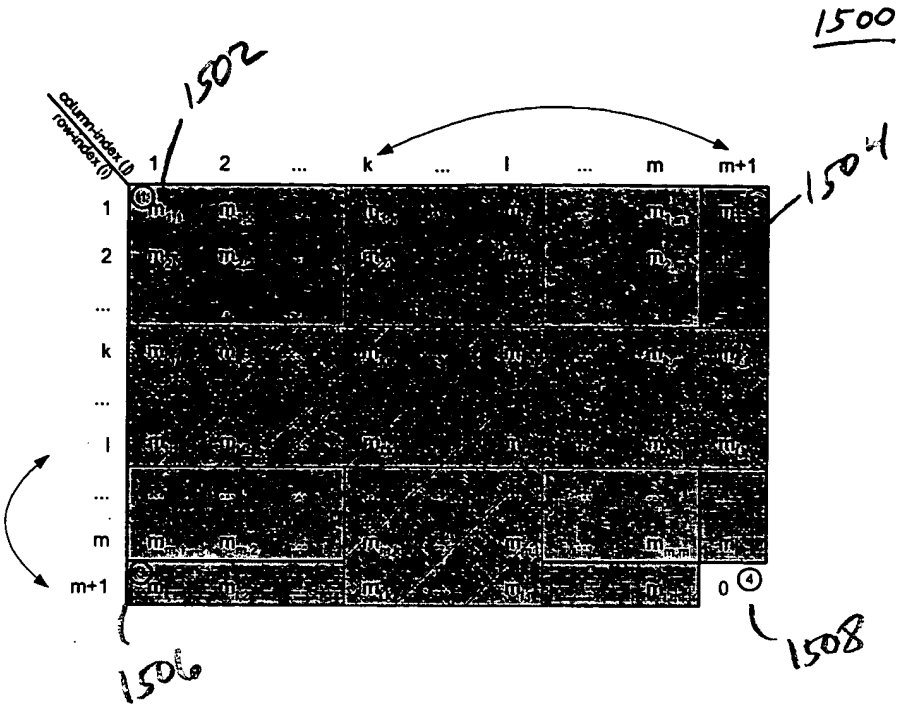

1500
1502
column-index (j)
row-index (i)
1
2
...
k
...
l
...
m
m+1
1504
1
2
...
k
...
l
...
m
m+1
0
1506
1508

FIG. 15

1600

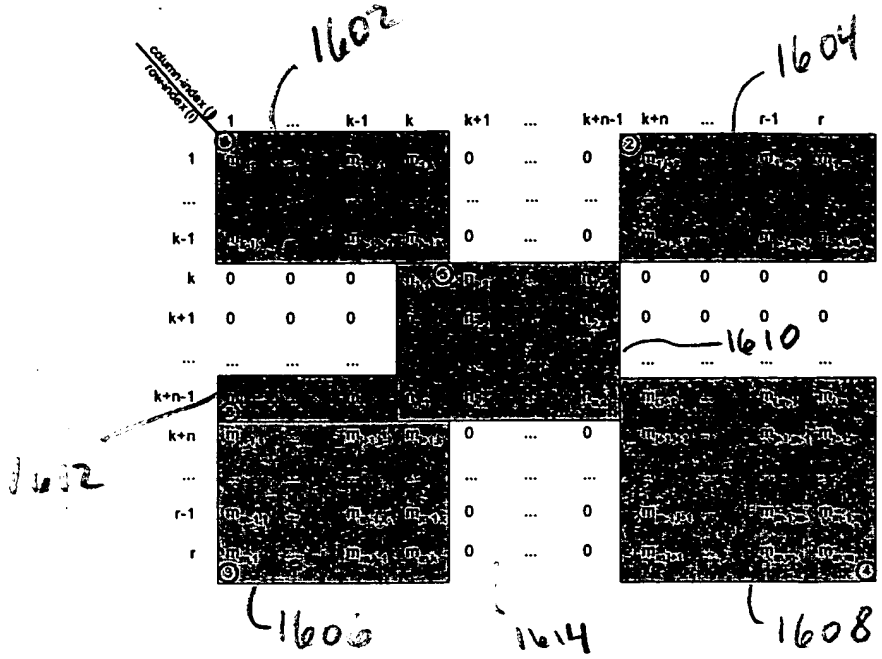

1602
1604
1610
1612
1606
1614
1608
column index (j)
row index (i)
1
...
k-1
k
k+1
...
k+n-1
k+n
...
r-1
r
0

FIG. 16

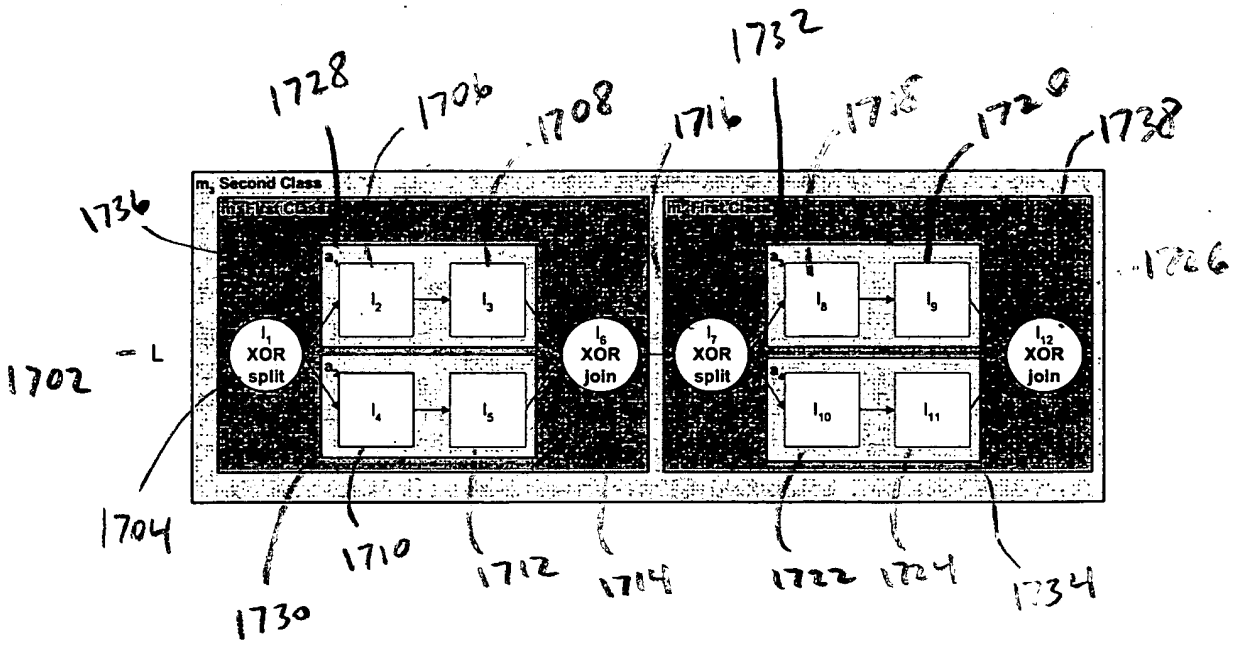

1728
1706
1708
1716
1732
1718
1720
1738
1736
1726
1702
L
1704
1710
1712
1714
1722
1724
1734
1730
m2 Second Class
I1 XOR split
I2
I3
I4
I5
I6 XOR join
I7 XOR split
I8
I9
I10
I11
I12 XOR join

FIG. 17

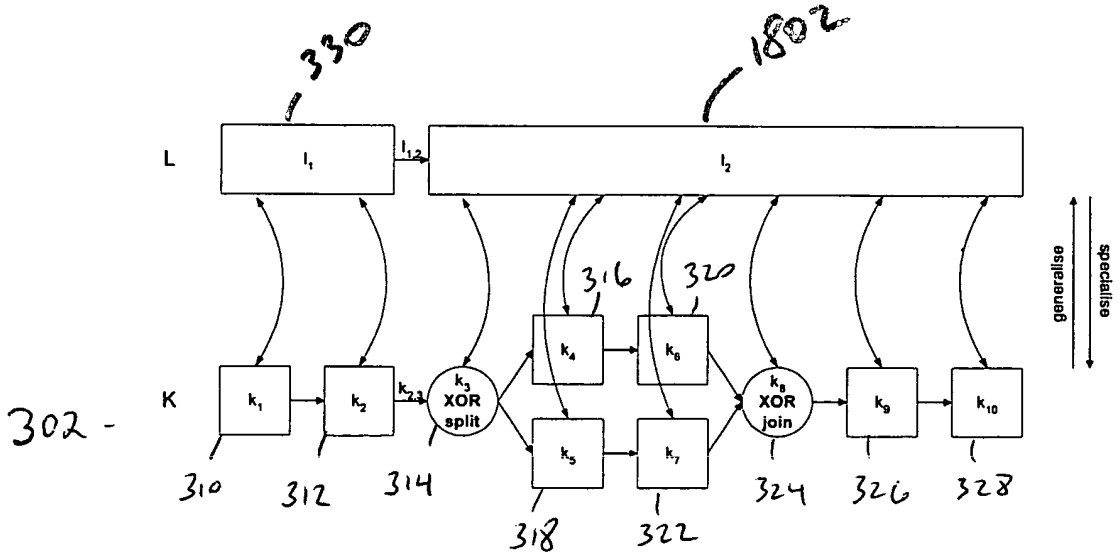

330
1802
L
K
302
l_1
$l_{1,2}$
l_2
k_1
k_2
$k_{2,3}$
k_3 XOR split
k_4
k_5
k_6
k_7
k_8 XOR join
k_9
k_{10}
316
320
generalise
specialise
310
312
314
318
322
324
326
328

FIG. 18

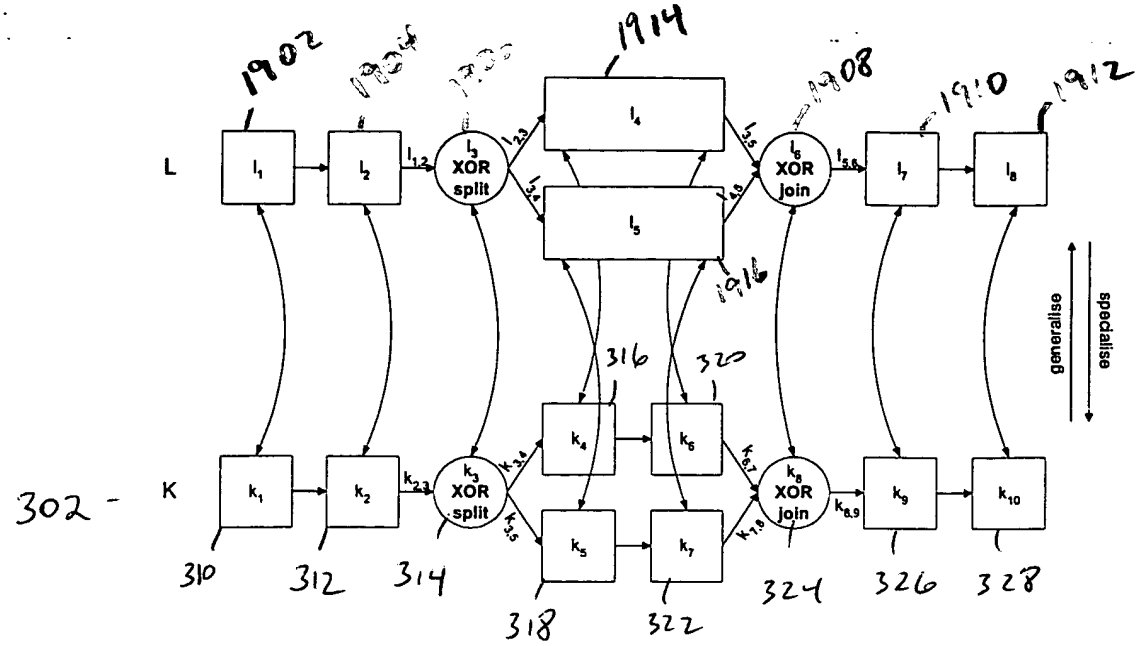
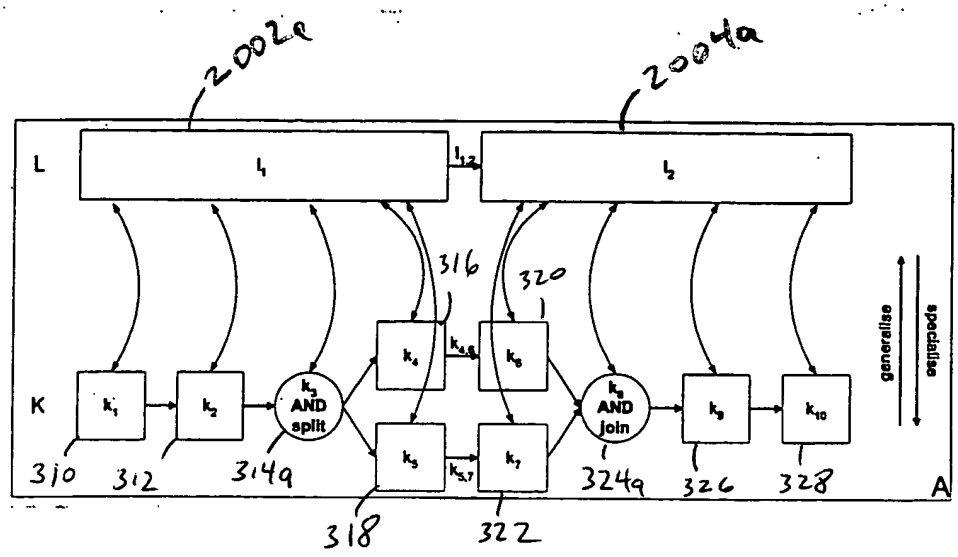

1902
1904
1906
1914
1908
1910
1912
L
K
302
XOR split
XOR join
generalise
specialise
316
320
310
312
314
318
322
324
326
328

FIG 19



302a

FIG. 20A

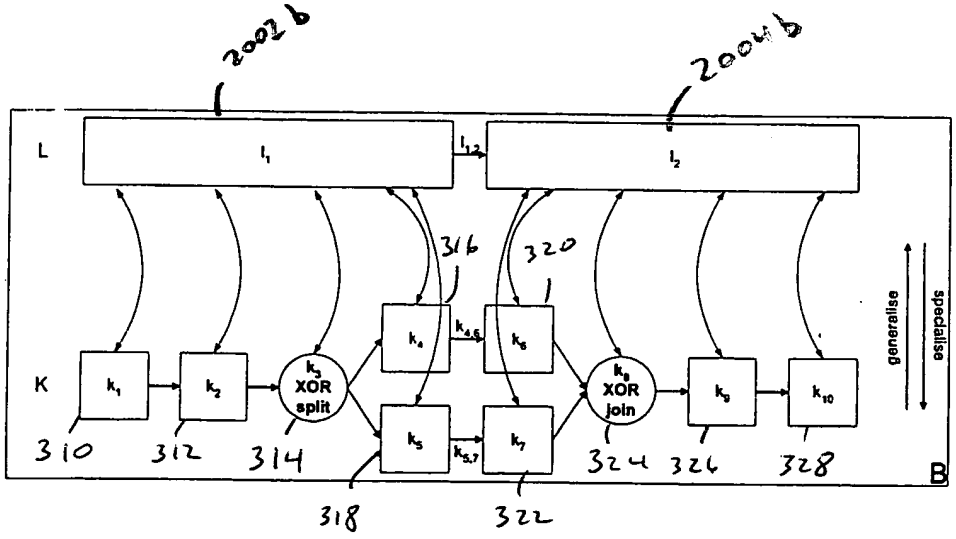


FIG 20B

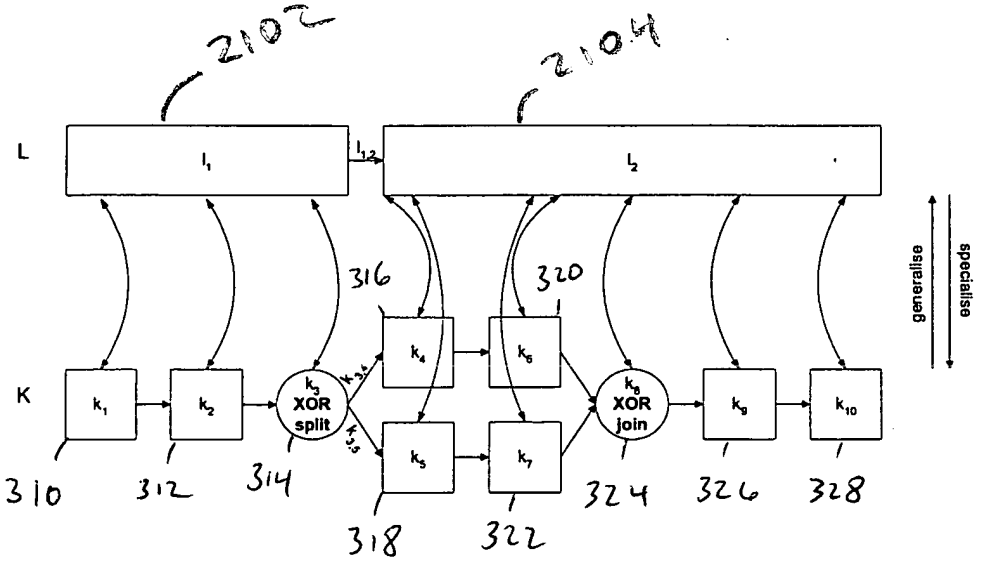

2102
2104
L
l_1
l_{12}
l_2
316
320
K
k_1
k_2
k_3 XOR split
k_4
k_5
k_6
k_7
k_8 XOR join
k_9
k_{10}
generalise
specialise
302
310
312
314
318
322
324
326
328

FIG. 21

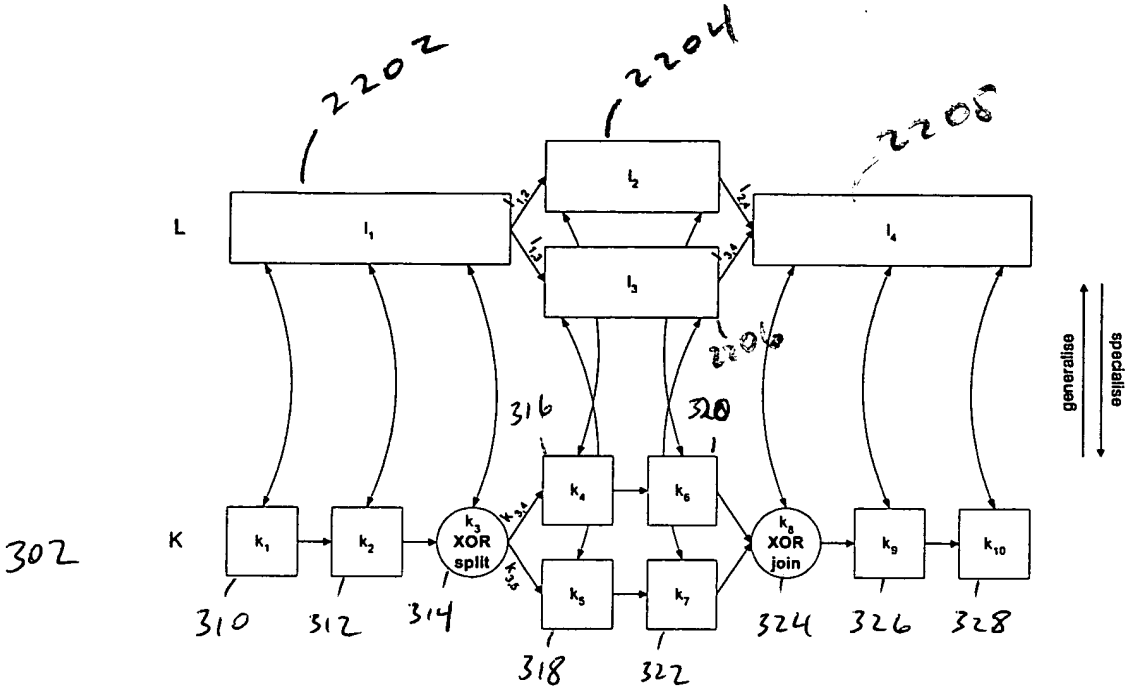

2202
2204
2206
L
K
302
generalise
specialise
XOR split
XOR join
310
312
314
316
318
320
322
324
326
328

FIG. 22

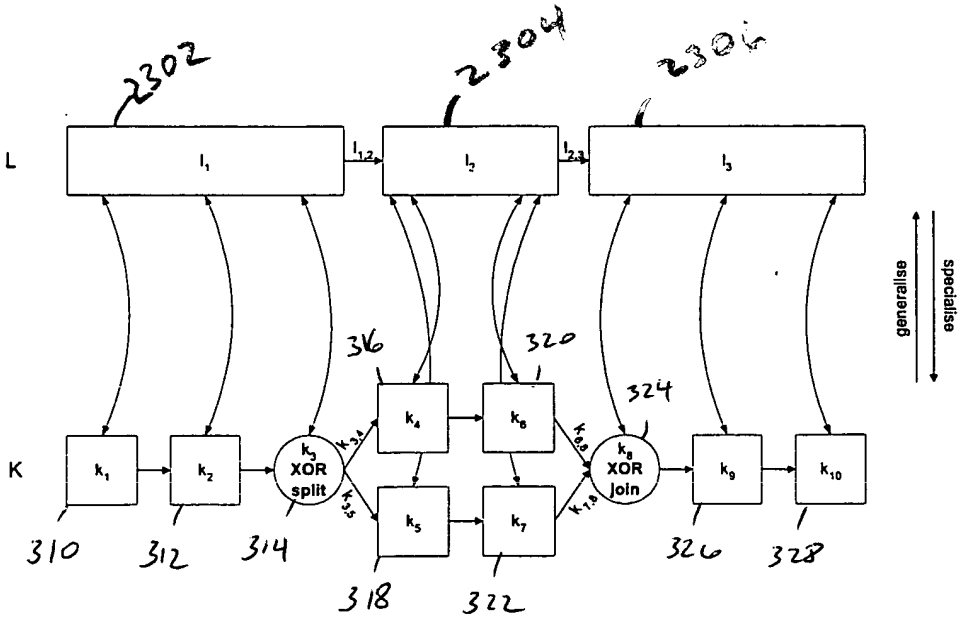

2302
2304
2306
L
l_1
l_2
l_3
$l_{1,2}$
$l_{2,3}$
generalise
specialise
316
320
324
K
k_1
k_2
k_3 XOR split
k_4
k_5
k_6
k_7
k_8 XOR join
k_9
k_{10}
$k_{3,4}$
$k_{3,5}$
$k_{6,8}$
$k_{7,8}$
302
310
312
314
318
322
326
328

FIG. 23

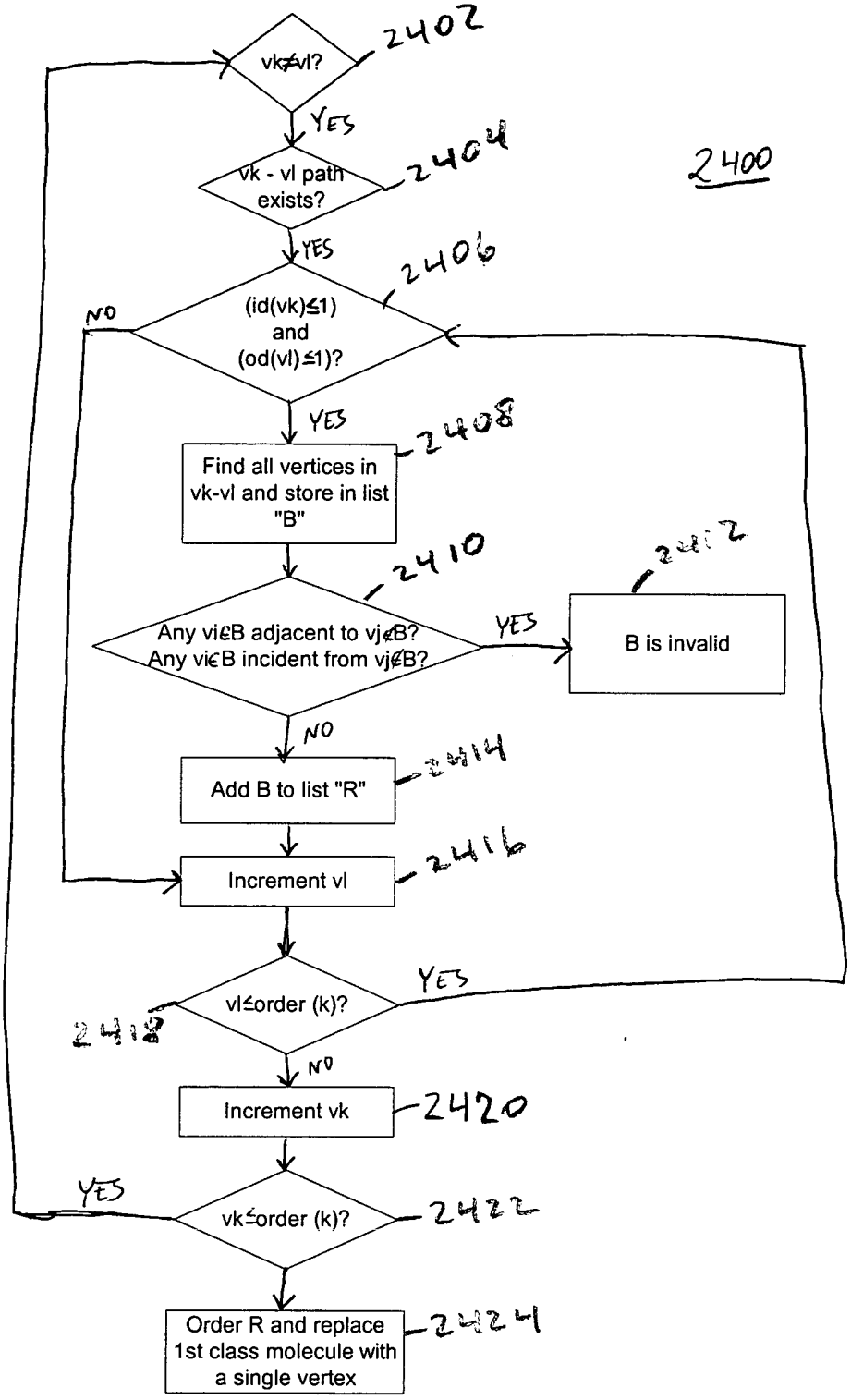

2400
vk≠vl?
2402
YES
vk - vl path exists?
2404
YES
(id(vk)≤1) and (od(vl)≤1)?
2406
NO
YES
Find all vertices in vk-vl and store in list "B"
2408
Any vi∈B adjacent to vj∉B? Any vi∈B incident from vj∉B?
2410
YES
B is invalid
NO
Add B to list "R"
Increment vl
2416
vl≤order (k)?
2418
YES
NO
Increment vk
2420
vk≤order (k)?
2422
YES
Order R and replace 1st class molecule with a single vertex
2424

FIG. 24

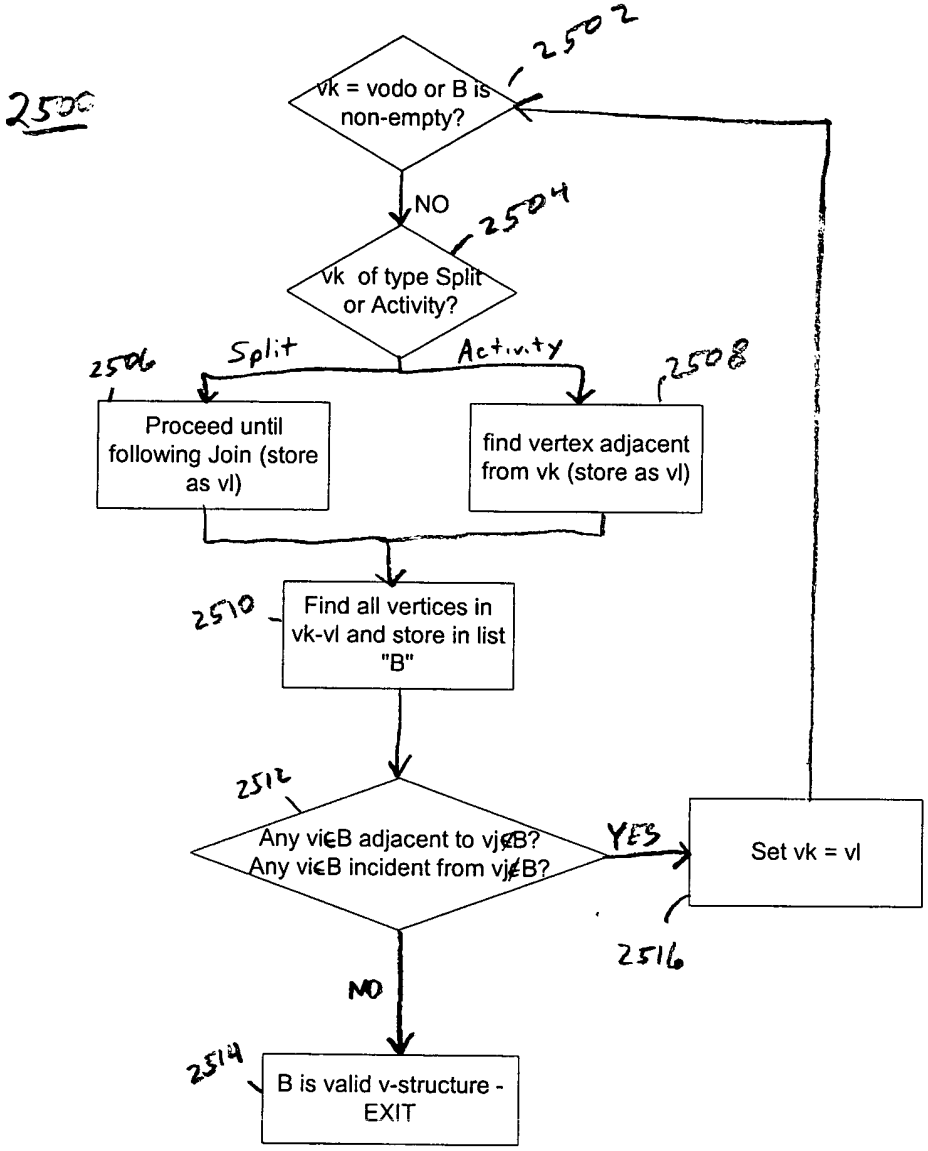

2500
2502
vk = vodo or B is non-empty?
NO
2504
vk of type Split or Activity?
Split
Activity
2506
Proceed until following Join (store as vl)
2508
find vertex adjacent from vk (store as vl)
2510
Find all vertices in vk-vl and store in list "B"
2512
Any vi∈B adjacent to vj∉B? Any vi∈B incident from vj∉B?
YES
Set vk = vl
2516
NO
2514
B is valid v-structure - EXIT

FIG. 25

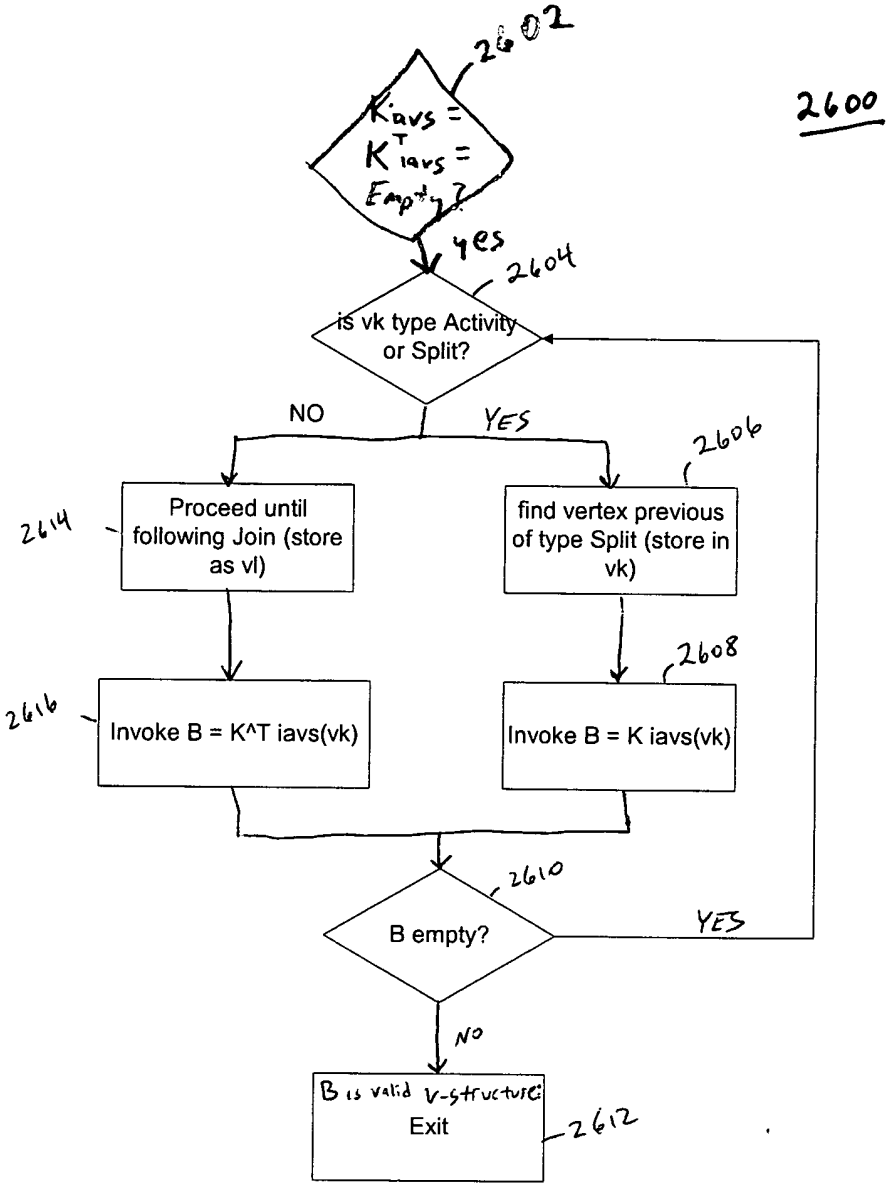

2600
2602
Kiavs = K^T iavs = Empty?
yes
2604
is vk type Activity or Split?
NO
YES
2606
Proceed until following Join (store as vl)
find vertex previous of type Split (store in vk)
2614
2608
2616
Invoke B = K^T iavs(vk)
Invoke B = K iavs(vk)
2610
B empty?
YES
NO
B is valid V-structure
Exit
2612

FIG. 26

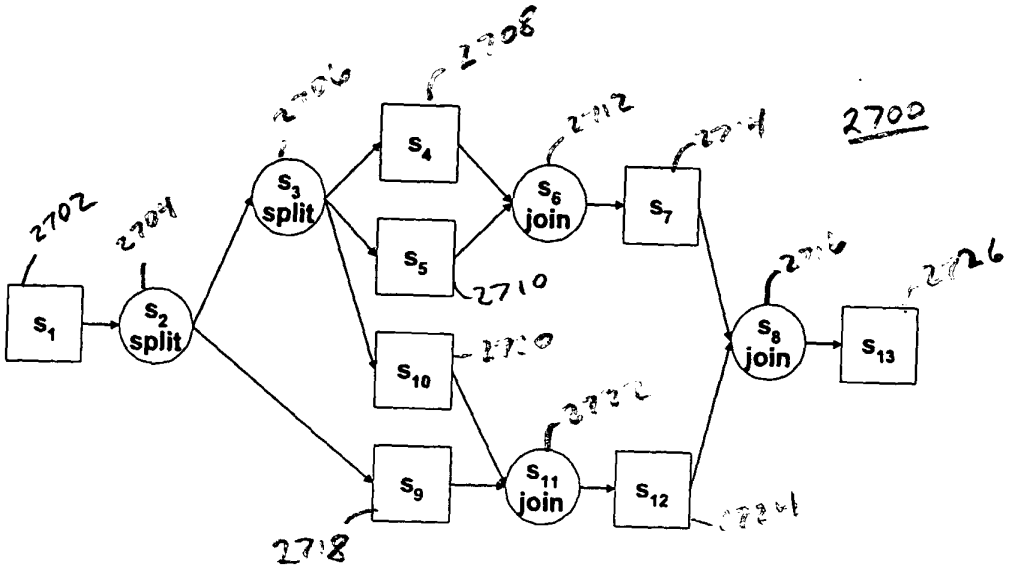


FIG. 27A

v_k	$S\,\mathrm{iavs}_e(v_k)$
s_1	$\{s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}\}$
s_2	$\{s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}\}$
s_3	$\{s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}\}$
s_4	$\{s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}\}$
s_5	$\{s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}\}$
s_6	$\{s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}\}$
s_7	$\{s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}\}$
s_8	$\{s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}\}$
s_9	$\{s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}\}$
s_{10}	$\{s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}\}$
s_{11}	$\{s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}\}$
s_{12}	$\{s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}\}$
s_{13}	$\{s_2, s_3, s_4, s_5, s_6, s_7, s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}\}$

FIG. 27B

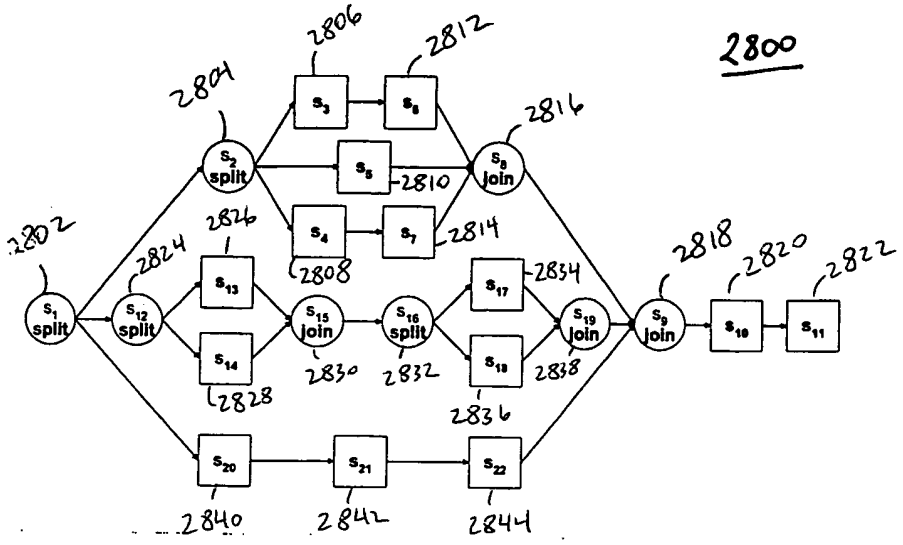


FIG. 28A

v_k	$Siavs_e(v_k)$
s_1	$\{s_1,s_2,s_3,s_4,s_5,s_6,s_7,s_8,s_9,s_{12},s_{13},s_{14},s_{15},s_{16},s_{17},s_{18},s_{19},s_{20},s_{21},s_{22}\}$
s_2	$\{s_2,s_3,s_4,s_5,s_6,s_7,s_8\}$
s_3	$\{s_3,s_6\}$
s_4	$\{s_4,s_7\}$
s_5	$\{s_2,s_3,s_4,s_5,s_6,s_7,s_8\}$
s_6	$\{s_3,s_6\}$
s_7	$\{s_4,s_7\}$
s_8	$\{s_2,s_3,s_4,s_5,s_6,s_7,s_8\}$
s_9	$\{s_1,s_2,s_3,s_4,s_5,s_6,s_7,s_8,s_9,s_{12},s_{13},s_{14},s_{15},s_{16},s_{17},s_{18},s_{19},s_{20},s_{21},s_{22}\}$
s_{10}	$\{s_1,s_2,s_3,s_4,s_5,s_6,s_7,s_8,s_9,s_{10},s_{12},s_{13},s_{14},s_{15},s_{16},s_{17},s_{18},s_{19},s_{20},s_{21},s_{22}\}$, $\{s_{10},s_{11}\}$
s_{11}	$\{s_{10},s_{11}\}$
s_{12}	$\{s_{12},s_{13},s_{14},s_{15}\}$
s_{13}	$\{s_{12},s_{13},s_{14},s_{15}\}$
s_{14}	$\{s_{12},s_{13},s_{14},s_{15}\}$
s_{15}	$\{s_{12},s_{13},s_{14},s_{15}\}$
s_{16}	$\{s_{16},s_{17},s_{18},s_{19}\}$
s_{17}	$\{s_{16},s_{17},s_{18},s_{19}\}$
s_{18}	$\{s_{16},s_{17},s_{18},s_{19}\}$
s_{19}	$\{s_{16},s_{17},s_{18},s_{19}\}$
s_{20}	$\{s_{20},s_{21}\}$
s_{21}	$\{s_{20},s_{21}\}$, $\{s_{21},s_{22}\}$
s_{22}	$\{s_{21},s_{22}\}$

FIG. 28B

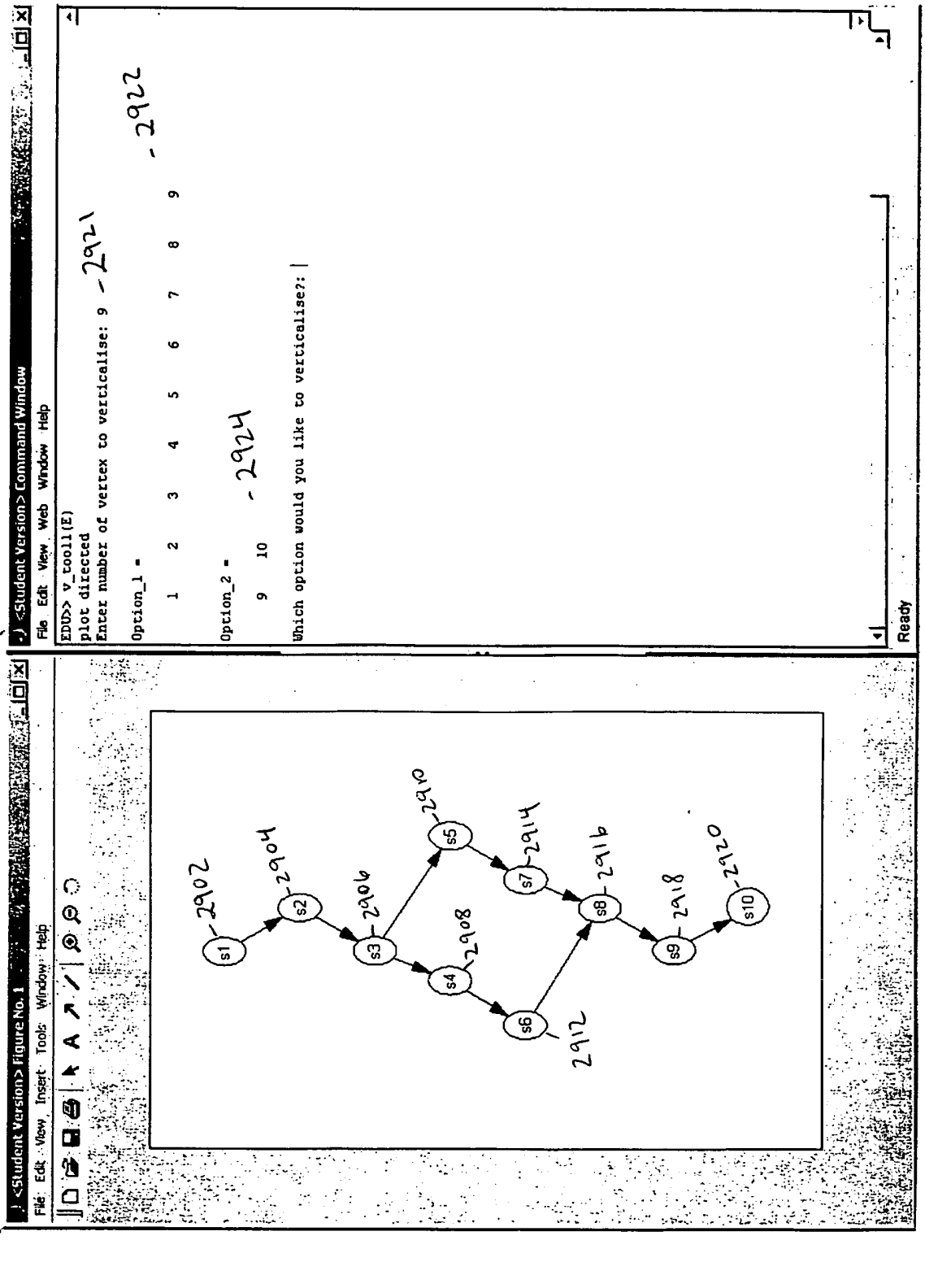

2900
2900A
2900B
<Student Version> Figure No. 1
File Edit View Insert Tools Window Help
<Student Version> Command Window
File Edit View Web Window Help
EDU>> v_tool1(E)
plot directed
Enter number of vertex to verticalise: 9
Option_1 =
1 2 3 4 5 6 7 8 9
Option_2 =
9 10
Which option would you like to verticalise?:
Ready
s1
s2
s3
s4
s5
s6
s7
s8
s9
s10
2902
2904
2906
2908
2910
2912
2914
2916
2918
2920
2921
2922
2924

FIG. 29

3000

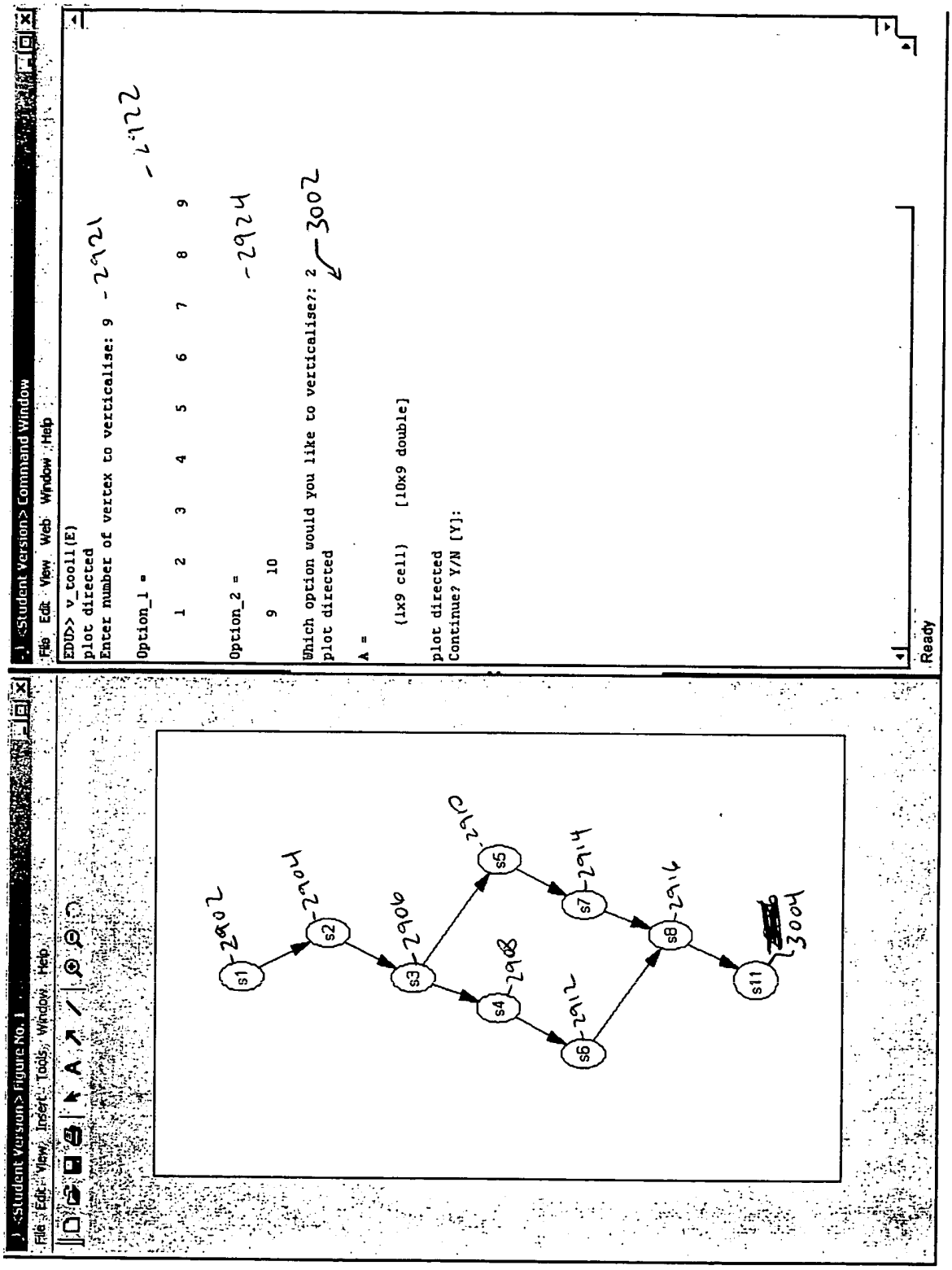

Student Version> Figure No. 1
File Edit View Insert Tools Window Help
s1
s2
s3
s4
s5
s6
s7
s8
s11
Student Version> Command Window
File Edit View Web Window Help
EDU>> v_coil(E)
plot directed
Enter number of vertex to verticalise: 9
Option_1 =
1 2 3 4 5 6 7 8 9
Option_2 =
9 10
Which option would you like to verticalise?: 2
plot directed
A =
(1x9 cell) [10x9 double]
plot directed
Continue? Y/N [Y]:
Ready

FIG. 30

3100

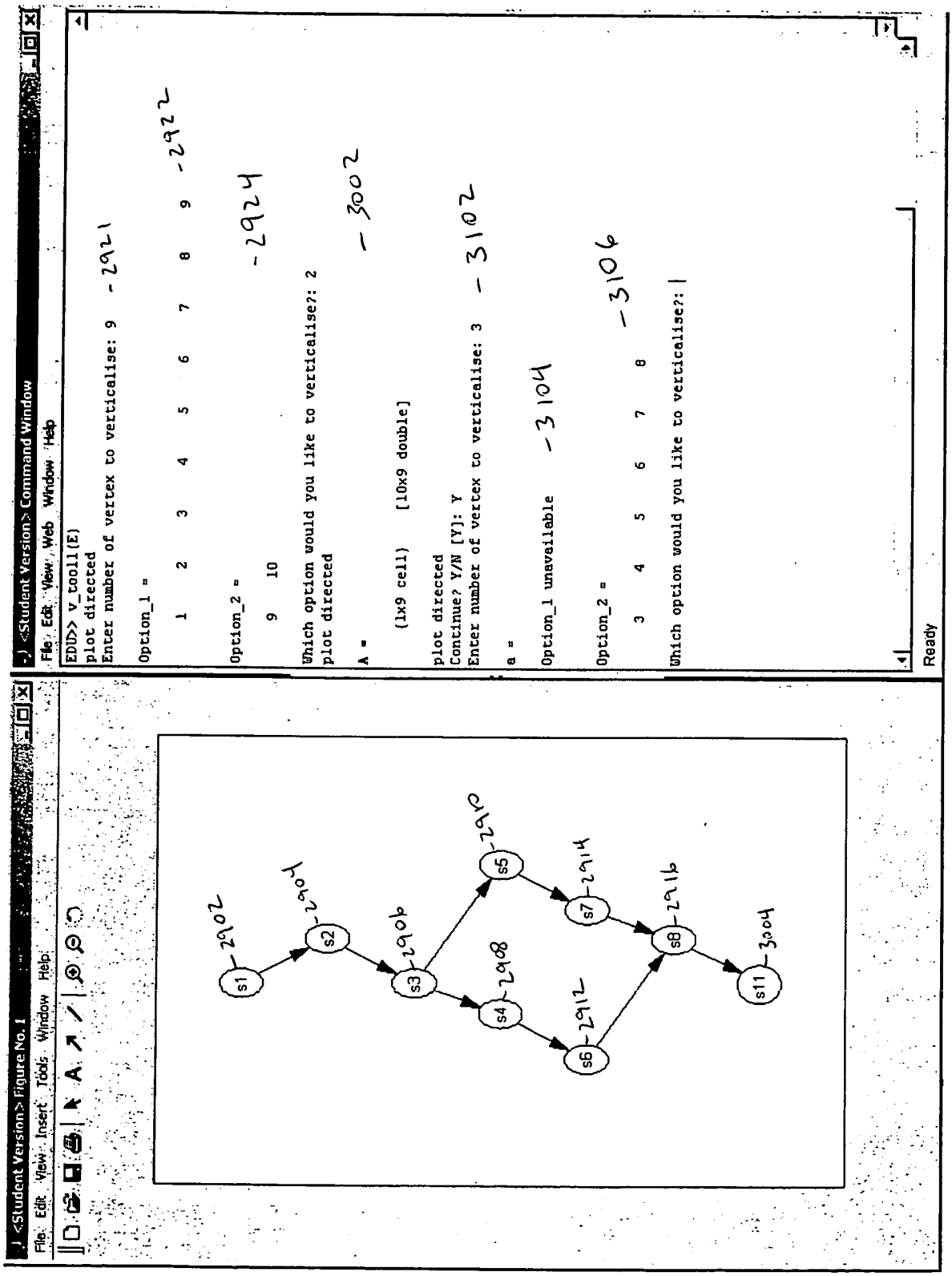

Student Version > Figure No. 1
File Edit View Insert Tools Window Help
s1
s2
s3
s4
s5
s6
s7
s8
s11
2902
2904
2906
2908
2910
2912
2914
2916
3004
Student Version > Command Window
File Edit View Web Window Help
EDU>> v_tool1(E)
plot directed
Enter number of vertex to verticalise: 9
-2921
Option_1 =
1 2 3 4 5 6 7 8 9
Option_2 =
9 10
-2924
Which option would you like to verticalise?: 2
plot directed
A =
(1x9 cell) [10x9 double]
-3002
plot directed
Continue? Y/N [Y]: Y
Enter number of vertex to verticalise: 3
-3102
a =
Option_1 unavailable
-3104
Option_2 =
3 4 5 6 7 8
-3106
Which option would you like to verticalise?:
Ready

FIG. 31

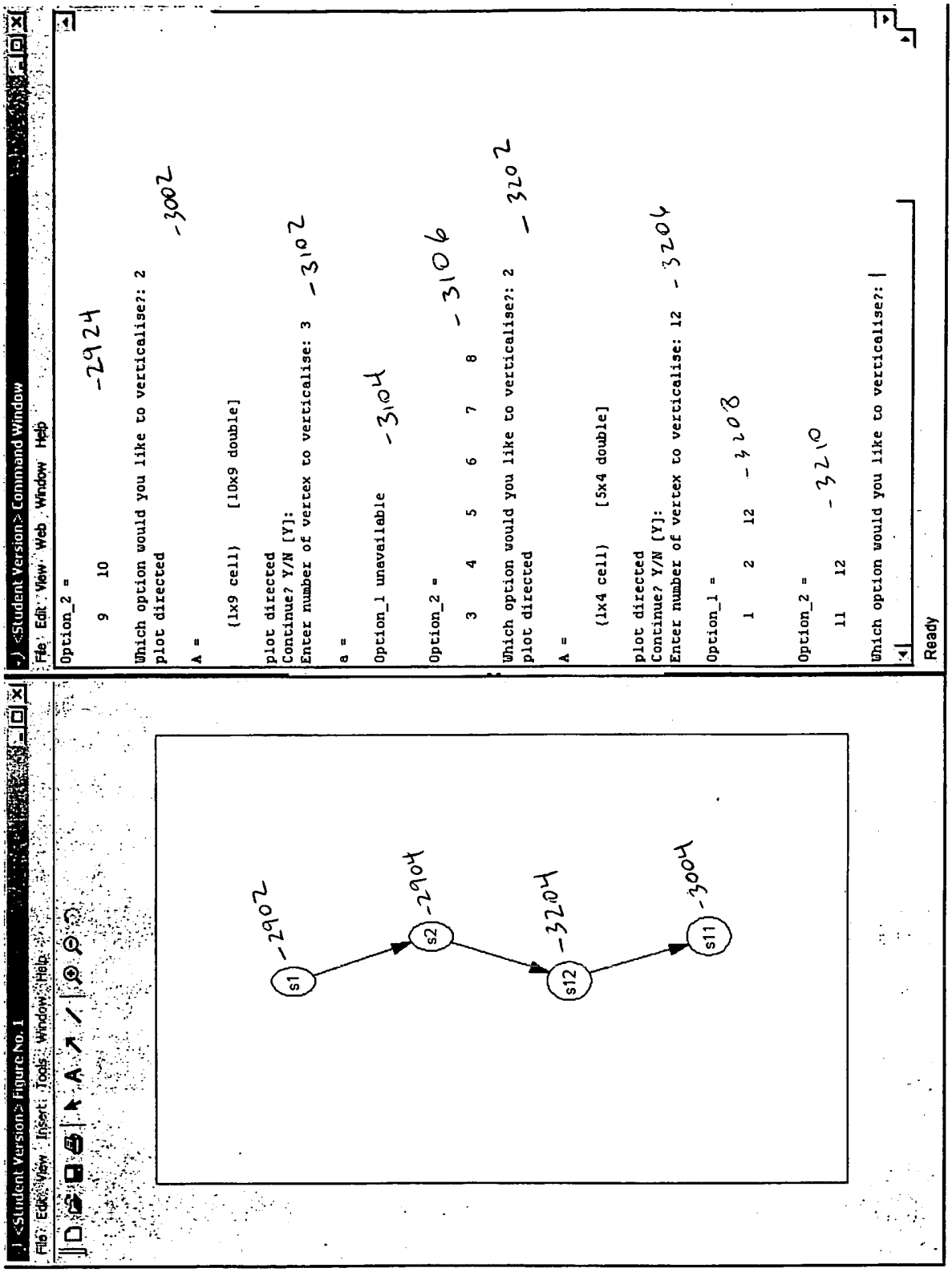

3200
-2902
-2904
-3204
-3004
s1
s2
s12
s11
-2924
-3002
-3104
-3106
-3102
-3204
-3208
-3210
-3202
Option_2 =
9 10
Which option would you like to verticalise?: 2
plot directed
A =
(1x9 cell) [10x9 double]
plot directed
Continue? Y/N [Y]:
Enter number of vertex to verticalise: 3
a =
Option_1 unavailable
Option_2 =
3 4 5 6 7 8
Which option would you like to verticalise?: 2
plot directed
A =
(1x4 cell) [5x4 double]
plot directed
Continue? Y/N [Y]:
Enter number of vertex to verticalise: 12
Option_1 =
1 2 12
Option_2 =
11 12
Which option would you like to verticalise?: 1
Ready

FIG 32

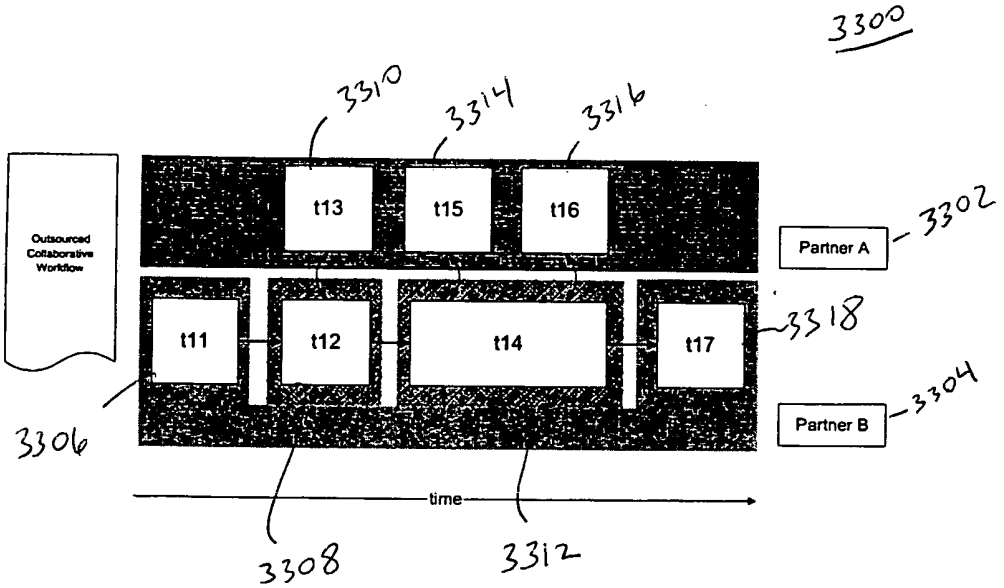

3300
3310
3314
3316
Outsourced Collaborative Workflow
t13
t15
t16
Partner A
3302
t11
t12
t14
t17
3318
3306
Partner B
3304
time
3308
3312

FIG. 33

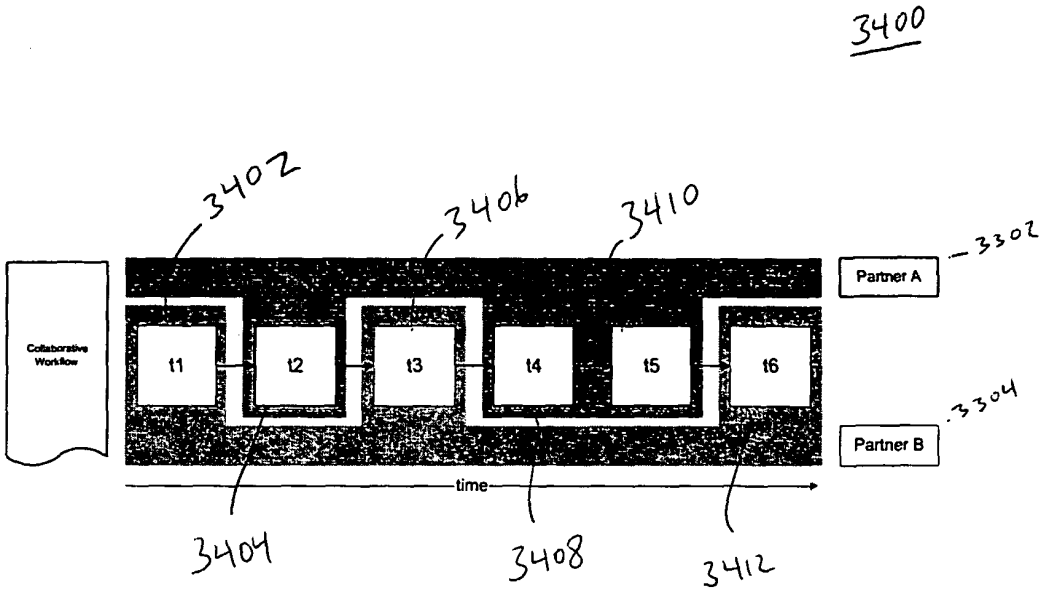

3400
3402
3406
3410
3302
Collaborative Workflow
t1
t2
t3
t4
t5
t6
Partner A
Partner B
3304
time
3404
3408
3412

FIG. 34

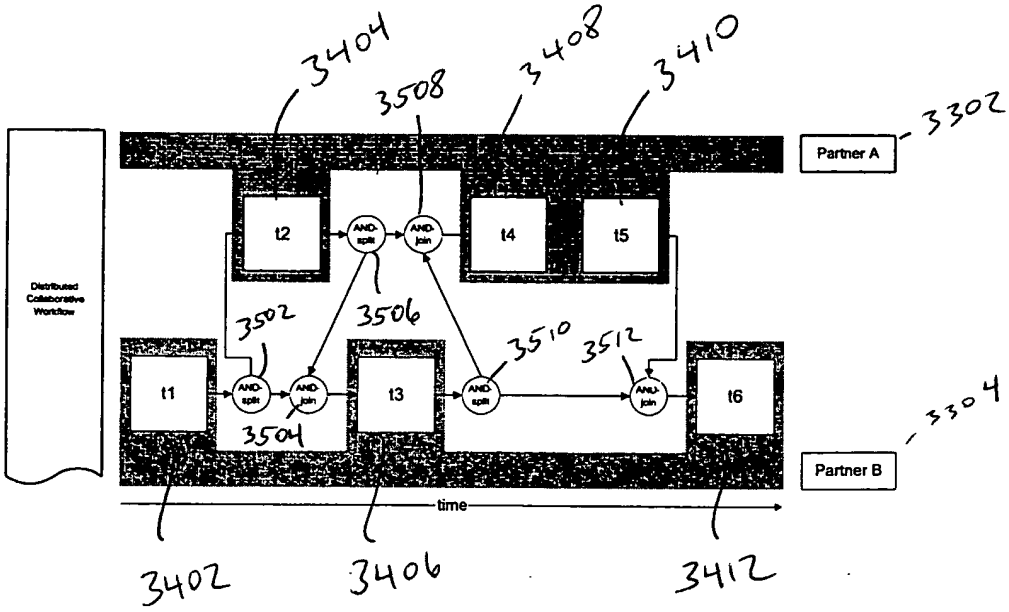

3404
3508
3408
3410
3302
Partner A
t2
AND-split
AND-join
t4
t5
Distributed Collaborative Workflow
3502
3506
3510
3512
t1
AND-split
AND-join
t3
AND-split
AND-join
t6
3504
3304
Partner B
time
3402
3406
3412

FIG. 35

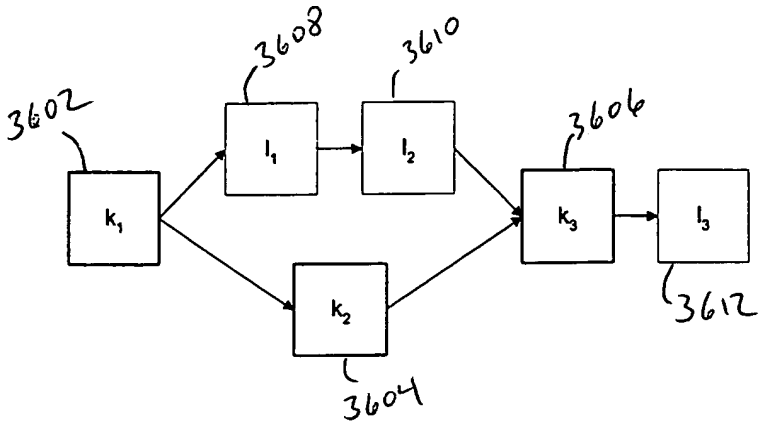


FIG. 36

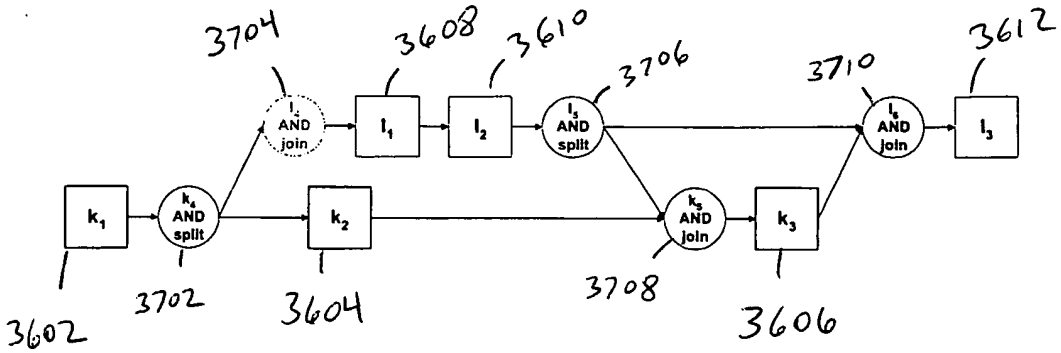

3704
3608
3610
3706
3710
3612
AND join
AND split
AND join
AND split
AND join
k_1
k_2
k_3
l_1
l_2
l_3
3602
3702
3604
3708
3606

FIG. 37

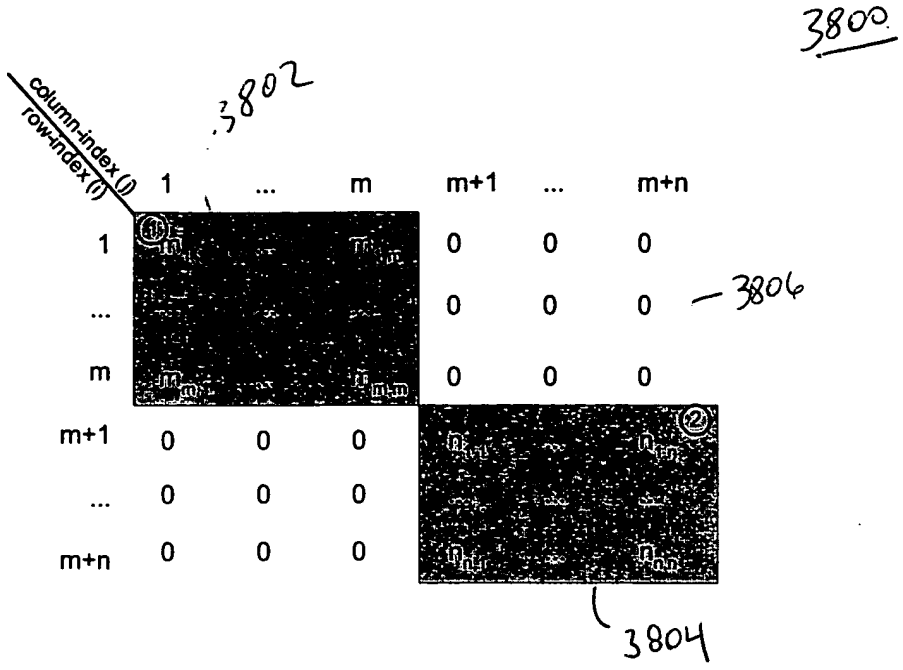

3800
3802
column-index (j)
row-index (i)
1
...
m
m+1
...
m+n
1
...
m
m+1
...
m+n
0
3806
3804

FIG. 38

3900

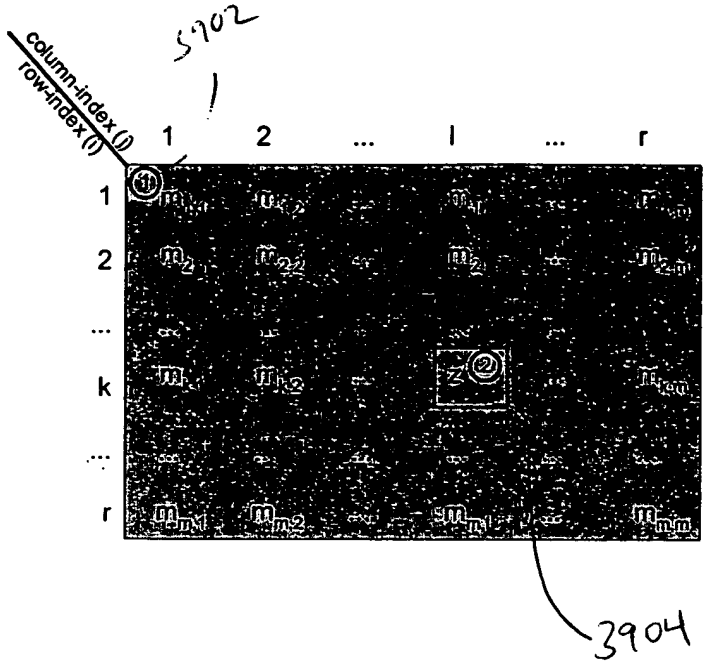


FIG. 39

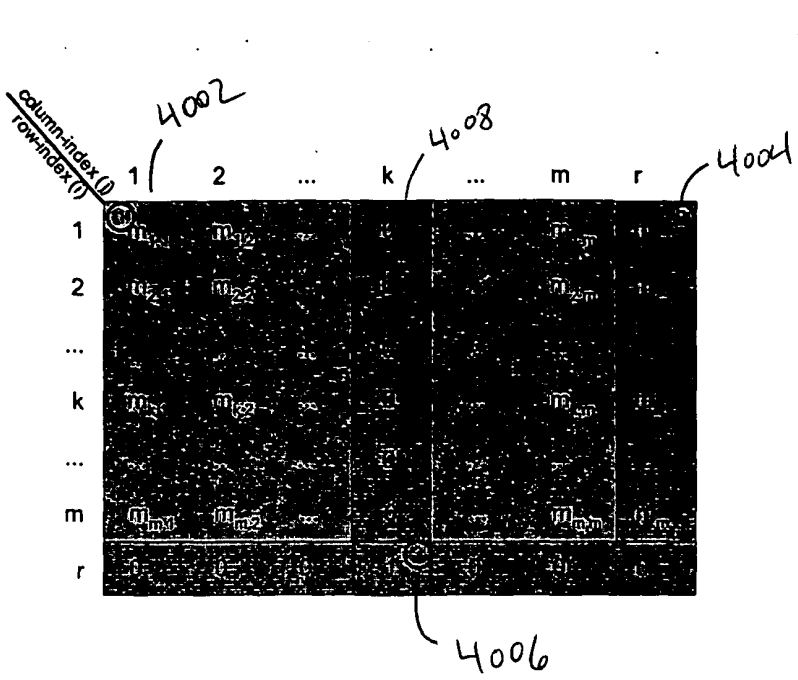


FIG. 40

4100

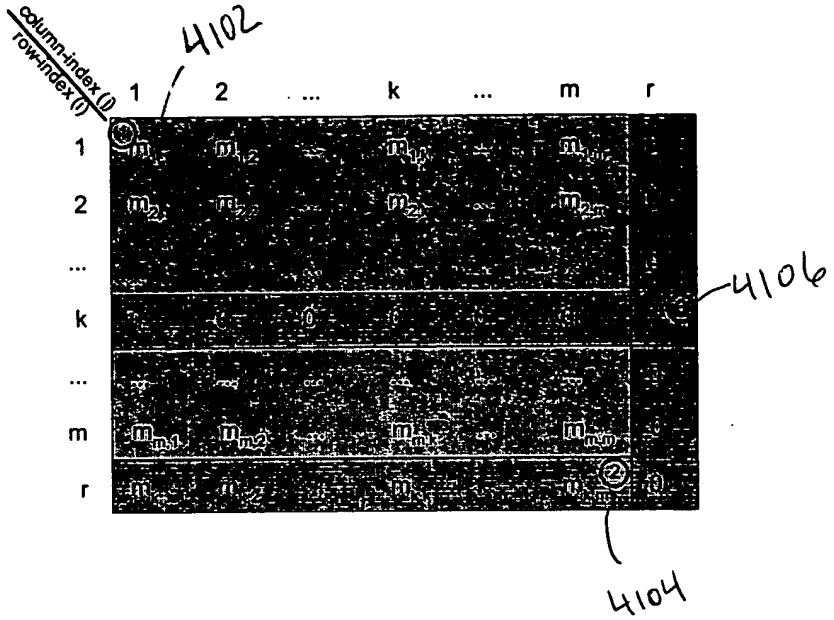


FIG. 41

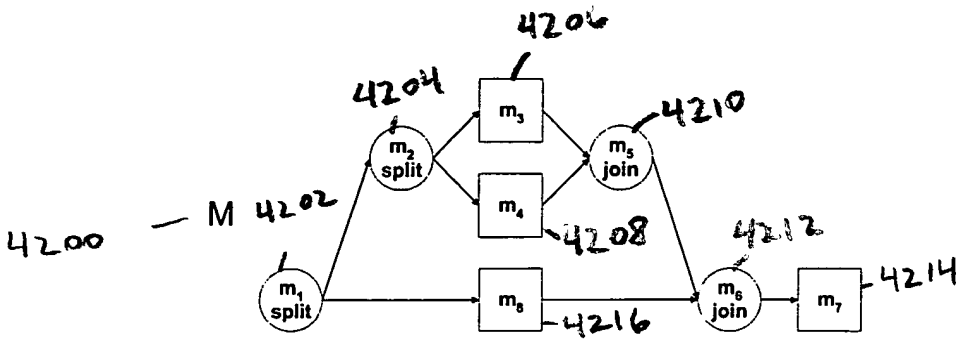


FIG. 42

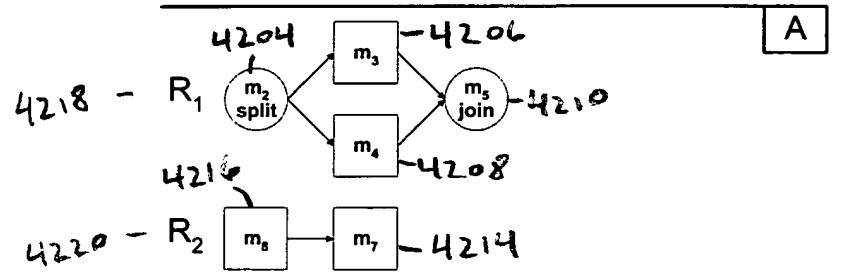


FIG. 42A

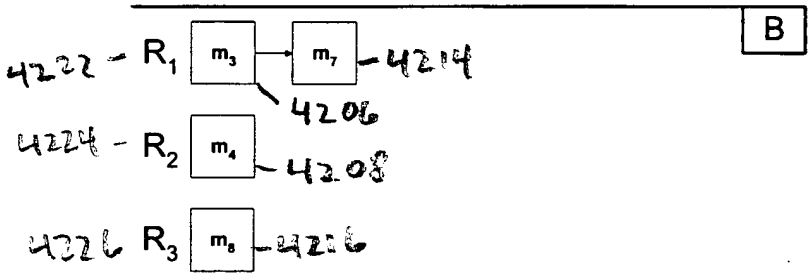


FIG. 42B

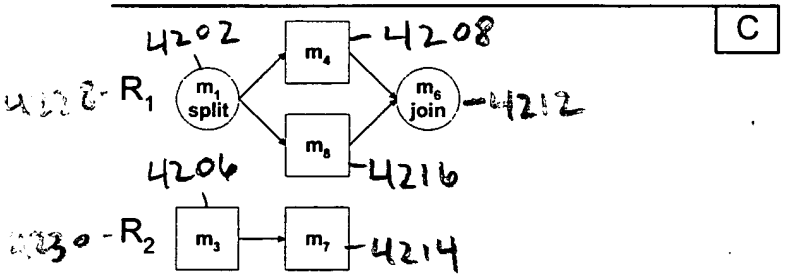


FIG. 42C

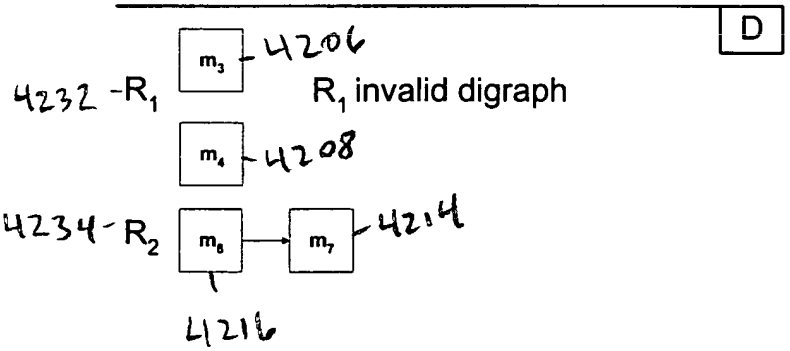


FIG. 42D

4302

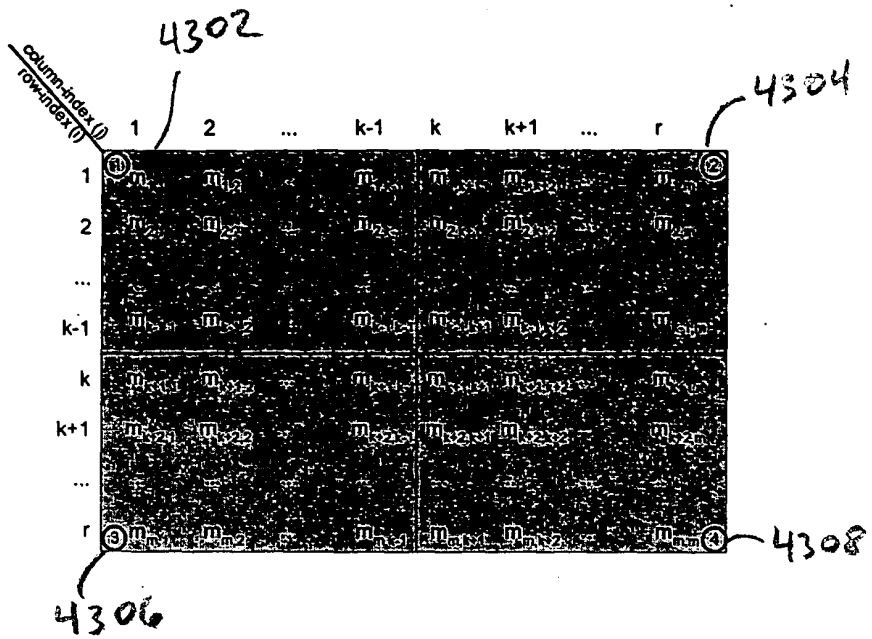


FIG. 43

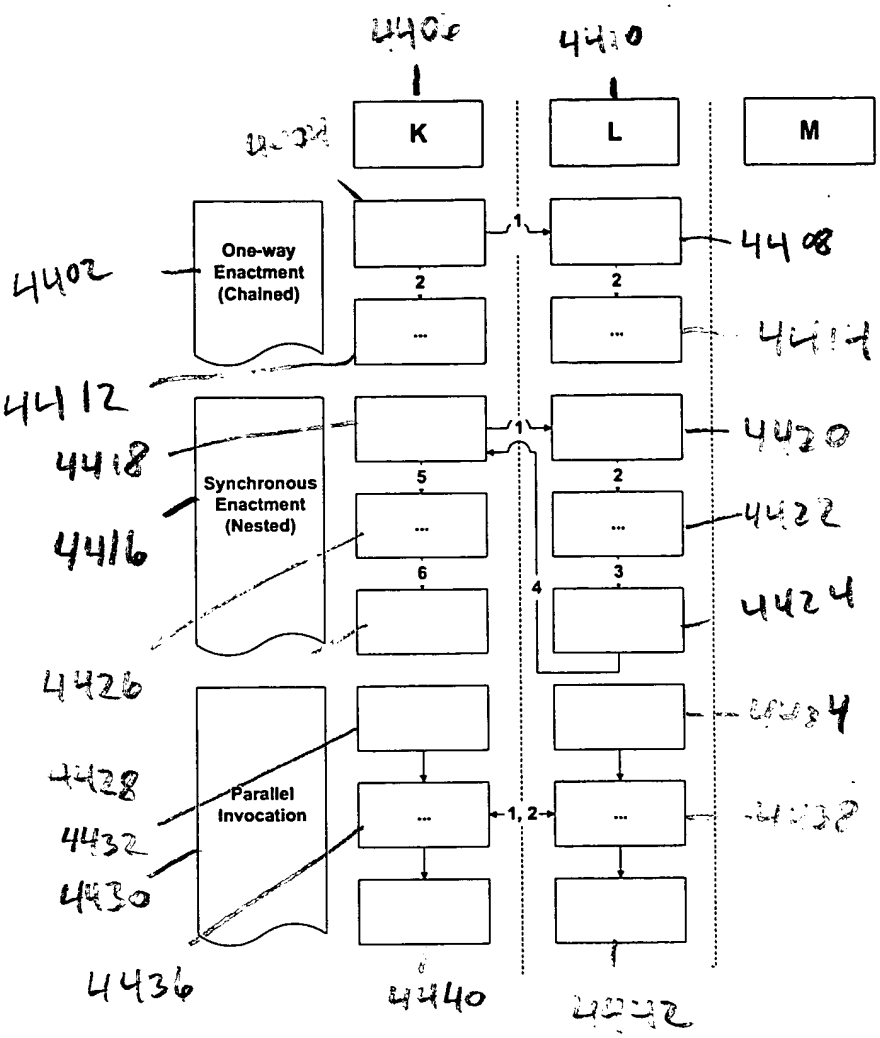

K
L
M
One-way Enactment (Chained)
Synchronous Enactment (Nested)
Parallel Invocation
1
2
...
5
6
4
3
1, 2

FIG. 44

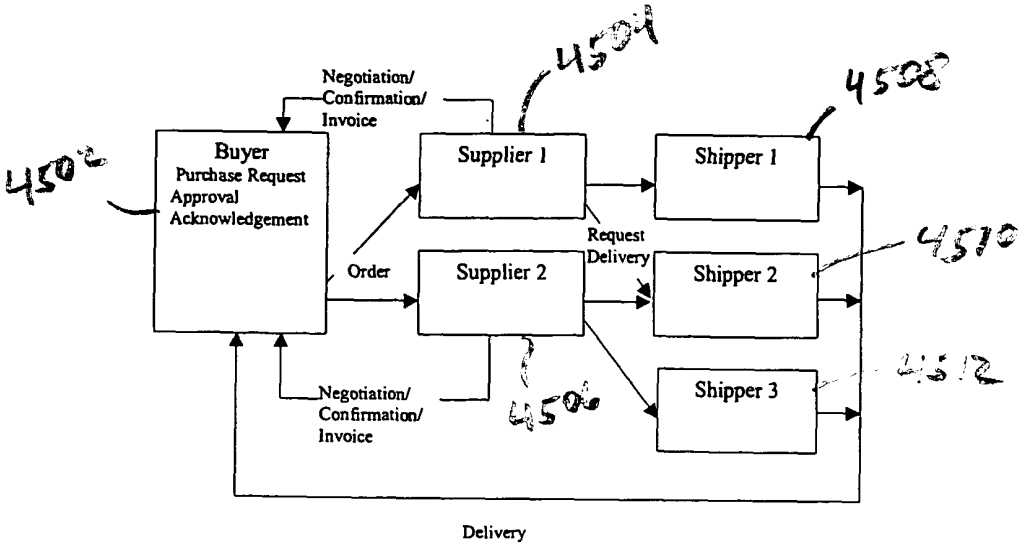

Negotiation/
Confirmation/
Invoice
Buyer
Purchase Request
Approval
Acknowledgement
Supplier 1
Shipper 1
Request
Delivery
Order
Supplier 2
Shipper 2
Shipper 3
Negotiation/
Confirmation/
Invoice
Delivery

FIG. 45

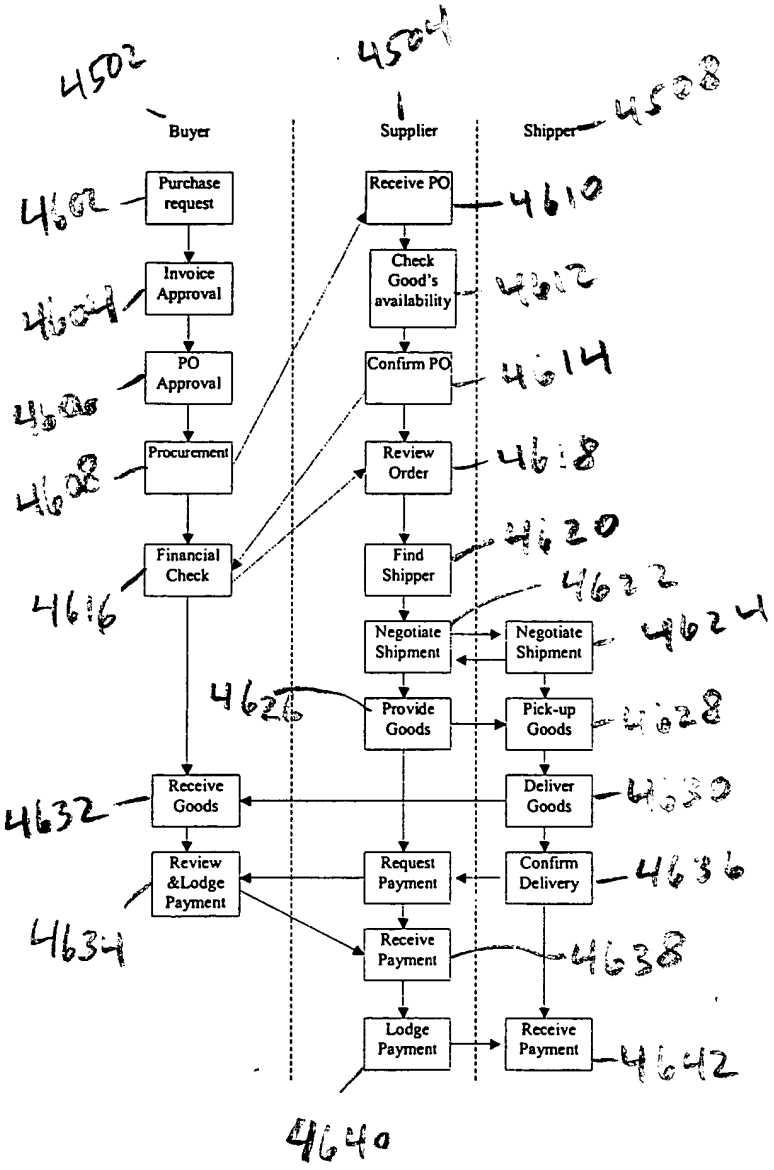

4502
4504
4508
Buyer
Supplier
Shipper
Purchase request
Invoice Approval
PO Approval
Procurement
Financial Check
Receive PO
Check Good's availability
Confirm PO
Review Order
Find Shipper
Negotiate Shipment
Provide Goods
Receive Goods
Review &Lodge Payment
Request Payment
Receive Payment
Lodge Payment
Negotiate Shipment
Pick-up Goods
Deliver Goods
Confirm Delivery
Receive Payment
4602
4604
4606
4608
4610
4612
4614
4616
4618
4620
4622
4624
4626
4628
4630
4632
4634
4636
4638
4640
4642

FIG. 46

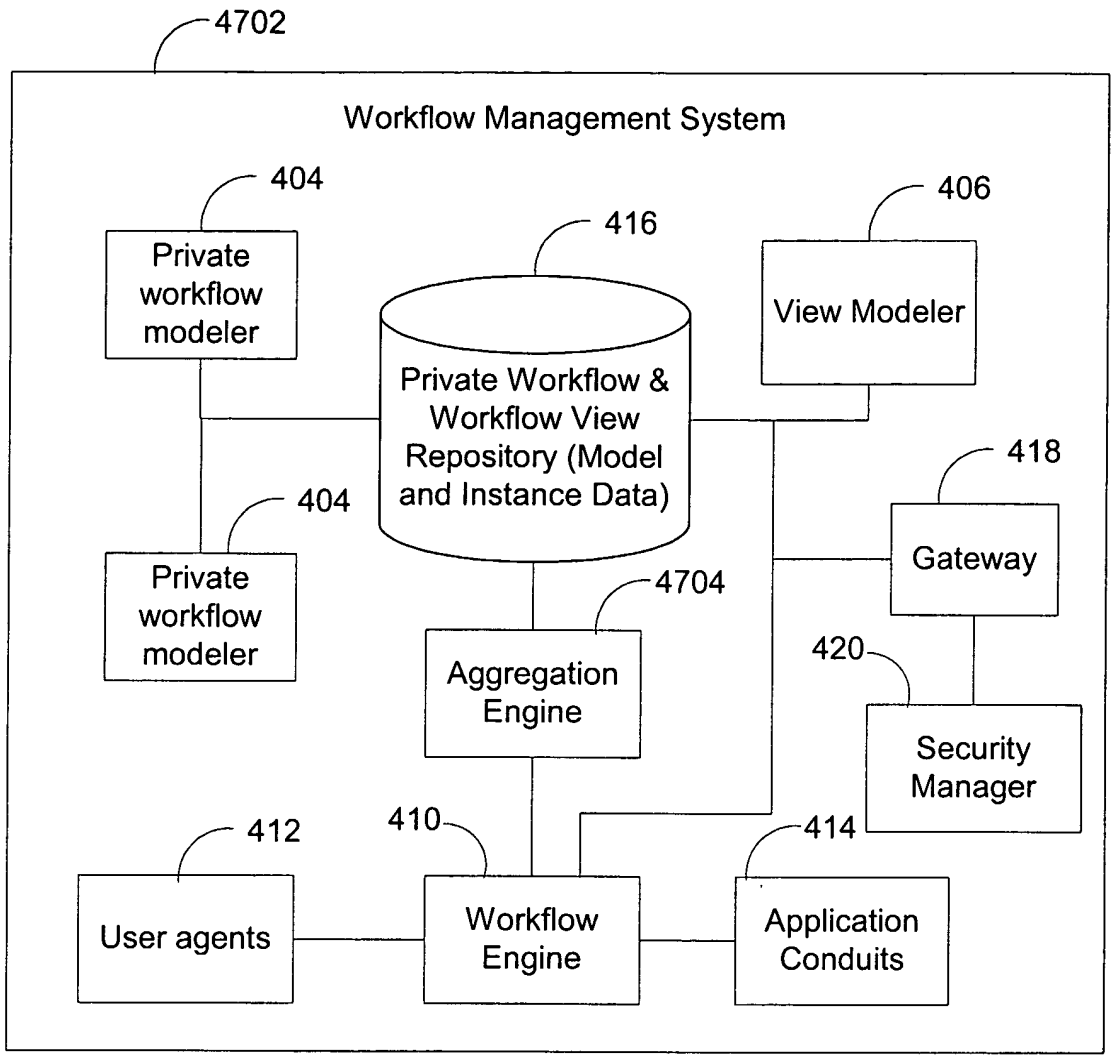

4702
Workflow Management System
404
Private workflow modeler
416
Private Workflow & Workflow View Repository (Model and Instance Data)
406
View Modeler
404
Private workflow modeler
418
Gateway
4704
Aggregation Engine
420
Security Manager
412
User agents
410
Workflow Engine
414
Application Conduits

FIG. 47

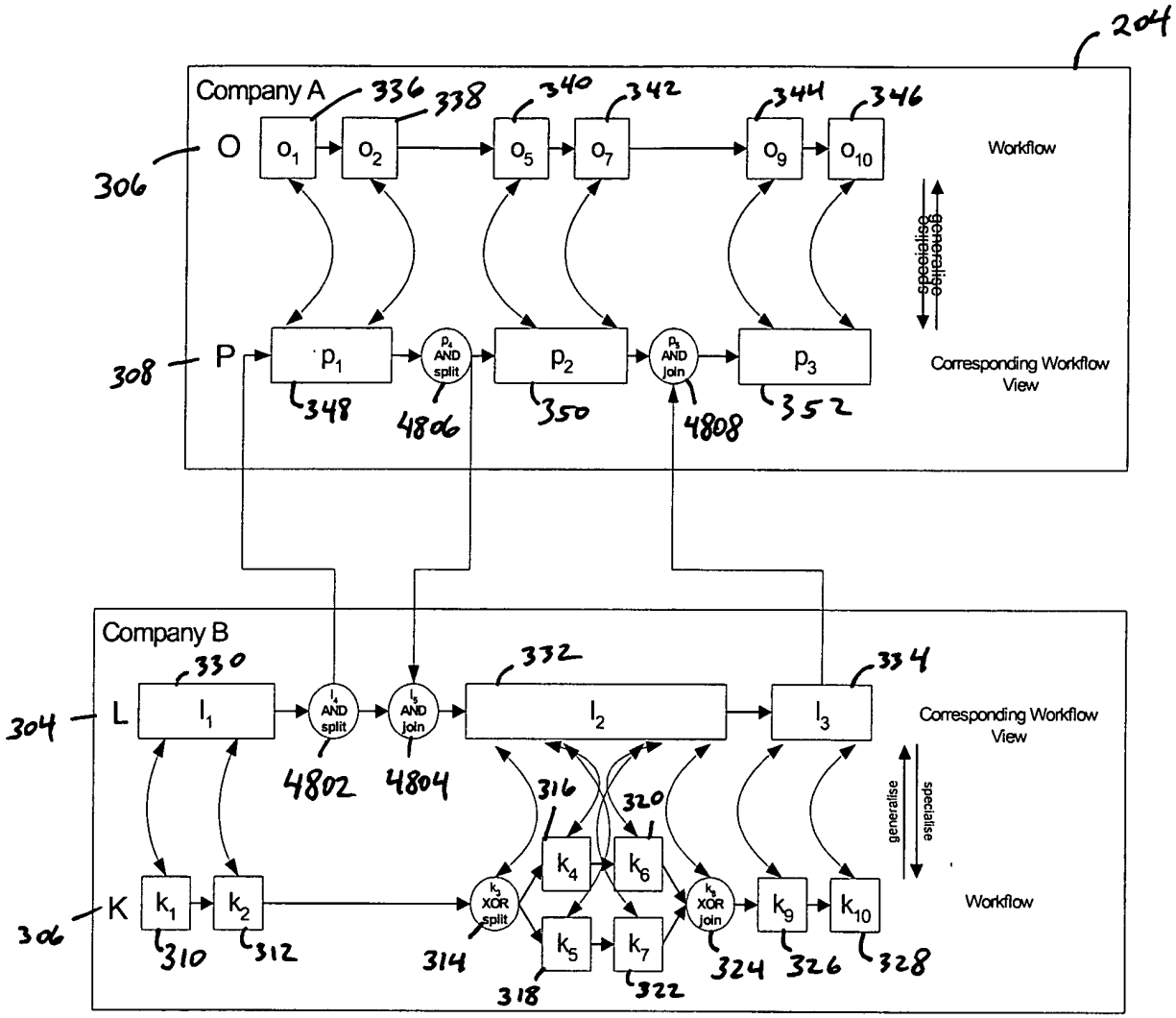

204
Company A
336
338
340
342
344
346
O
306
o_1
o_2
o_5
o_7
o_9
o_{10}
Workflow
generalise
specialise
P
308
p_1
p_2
p_3
p_4 AND split
p_5 AND join
348
4806
350
4808
352
Corresponding Workflow View
Company B
330
332
334
L
304
l_1
l_2
l_3
l_4 AND split
l_5 AND join
4802
4804
316
320
K
306
k_1
k_2
k_3 XOR split
k_4
k_5
k_6
k_7
k_8 XOR join
k_9
k_{10}
310
312
314
318
322
324
326
328
Corresponding Workflow View
generalise
specialise
Workflow

FIG. 48

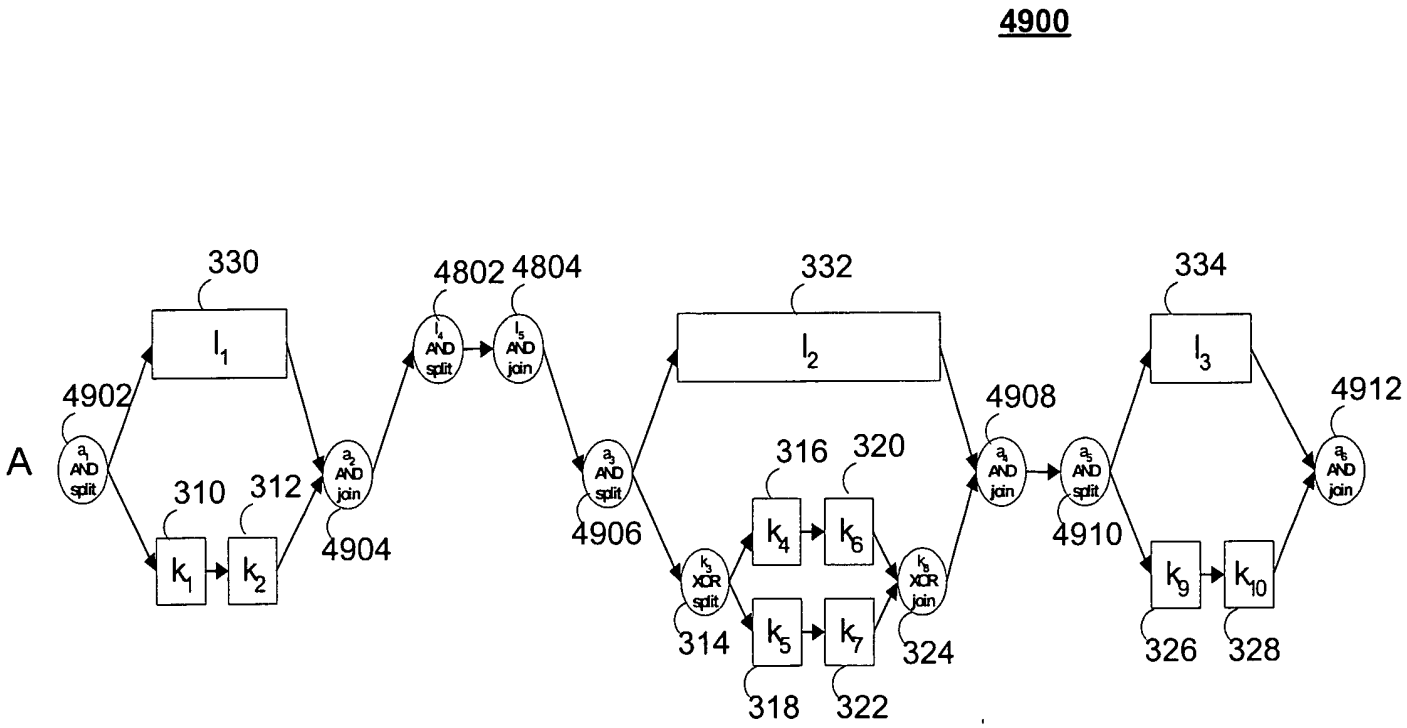

4900
A
330
4902
l_1
a_1 AND split
310
312
k_1
k_2
a_2 AND join
4904
4802
4804
l_4 AND split
l_5 AND join
332
l_2
a_3 AND split
4906
316
320
k_3 XOR split
k_4
k_6
k_5
k_7
k_8 XOR join
314
318
322
324
4908
a_4 AND join
a_5 AND split
4910
334
l_3
4912
a_6 AND join
k_9
k_{10}
326
328

FIG. 49

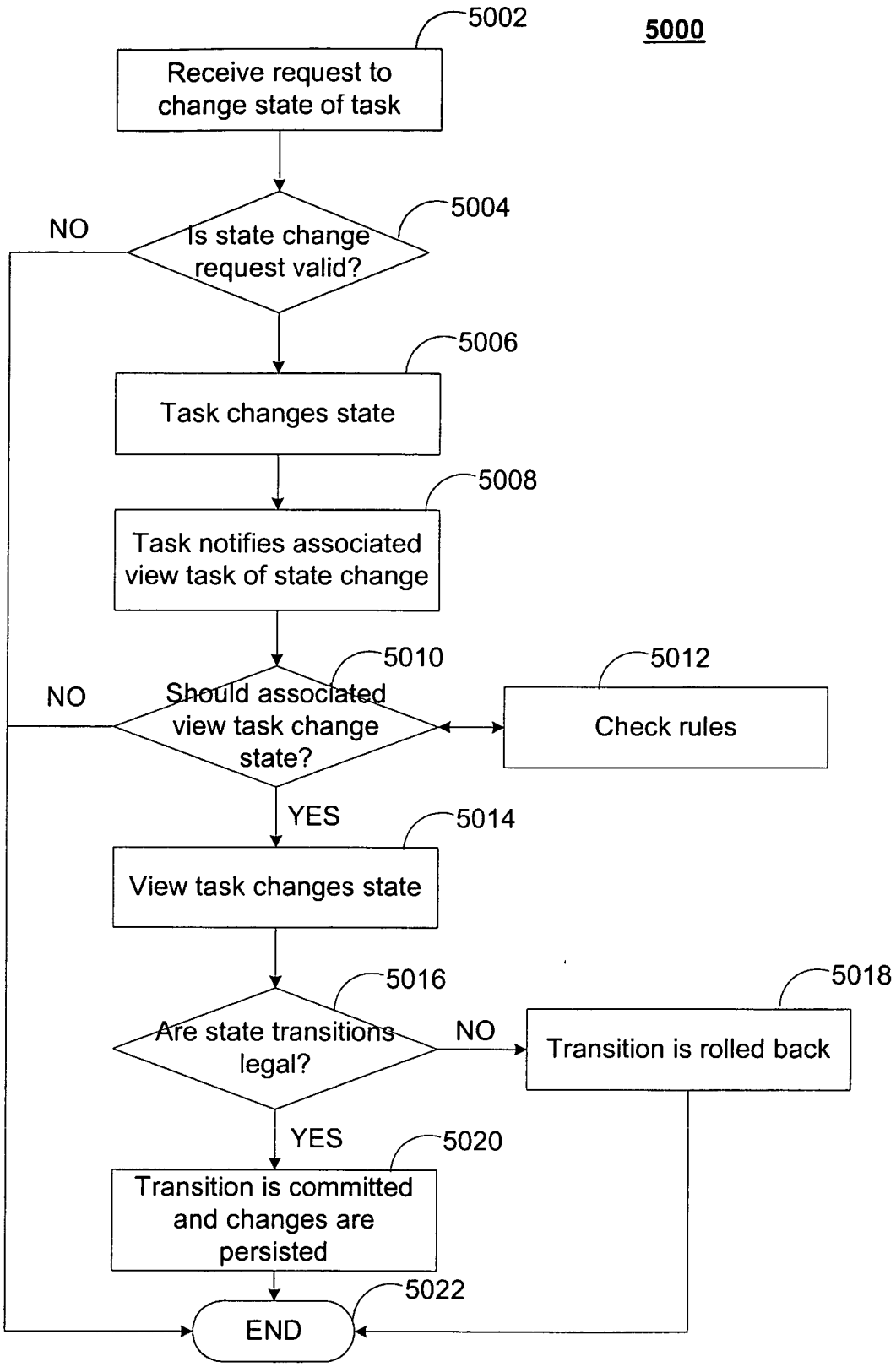

5000
5002
Receive request to change state of task
5004
Is state change request valid?
NO
5006
Task changes state
5008
Task notifies associated view task of state change
5010
Should associated view task change state?
NO
5012
Check rules
YES
5014
View task changes state
5016
Are state transitions legal?
NO
5018
Transition is rolled back
YES
5020
Transition is committed and changes are persisted
5022
END

FIG. 50

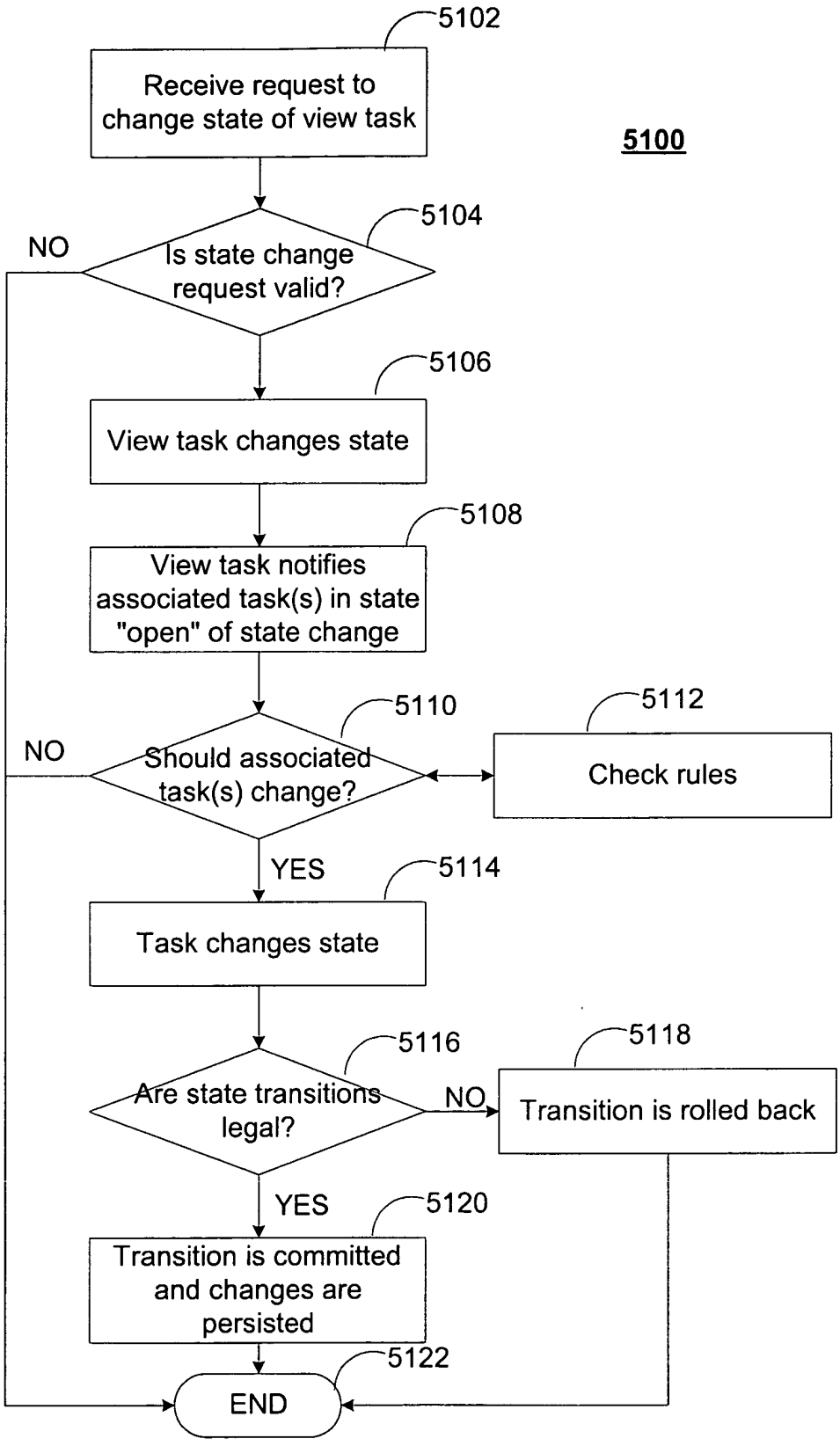

5100
5102
Receive request to change state of view task
5104
Is state change request valid?
NO
5106
View task changes state
5108
View task notifies associated task(s) in state "open" of state change
5110
Should associated task(s) change?
NO
5112
Check rules
YES
5114
Task changes state
5116
Are state transitions legal?
NO
5118
Transition is rolled back
YES
5120
Transition is committed and changes are persisted
5122
END

FIG. 51

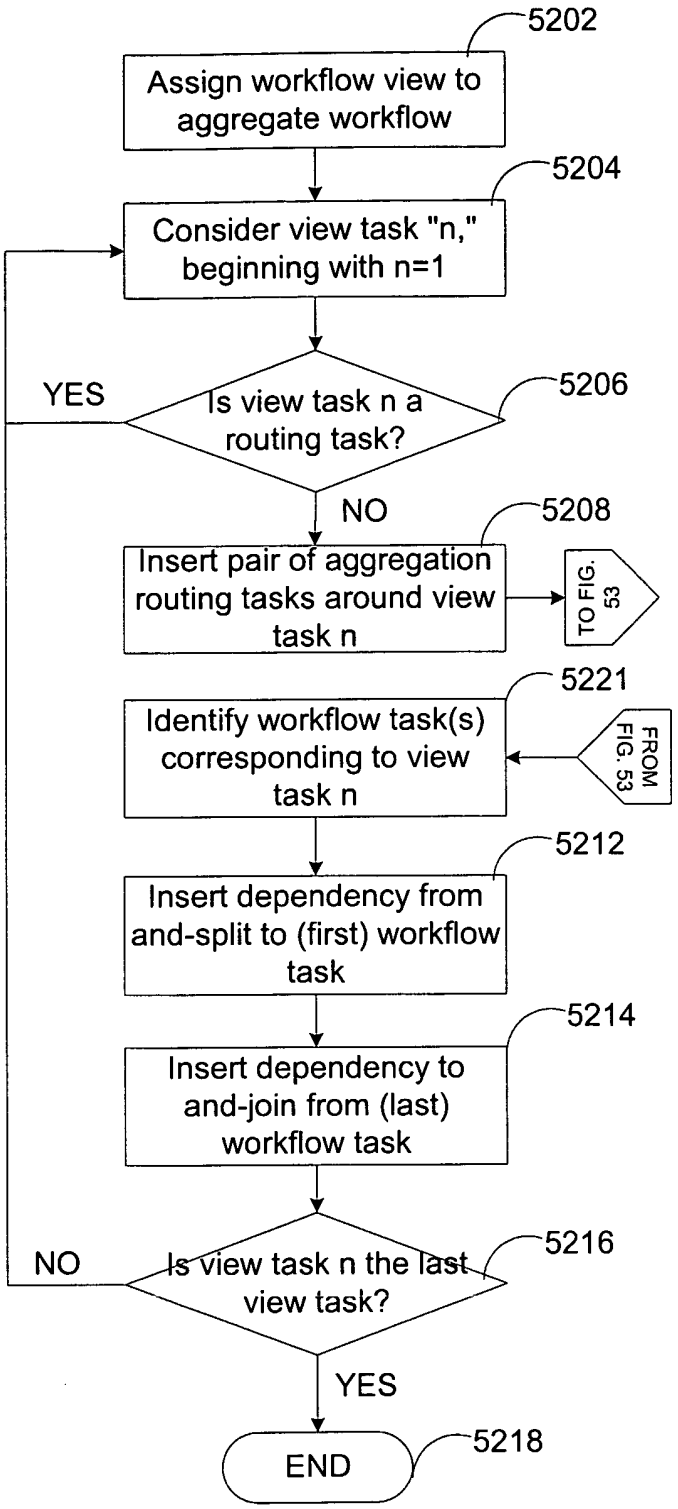

5200
5202
Assign workflow view to aggregate workflow
5204
Consider view task "n," beginning with n=1
YES
Is view task n a routing task?
5206
NO
5208
Insert pair of aggregation routing tasks around view task n
TO FIG. 53
5221
Identify workflow task(s) corresponding to view task n
FROM FIG. 53
5212
Insert dependency from and-split to (first) workflow task
5214
Insert dependency to and-join from (last) workflow task
NO
Is view task n the last view task?
5216
YES
END
5218

FIG. 52

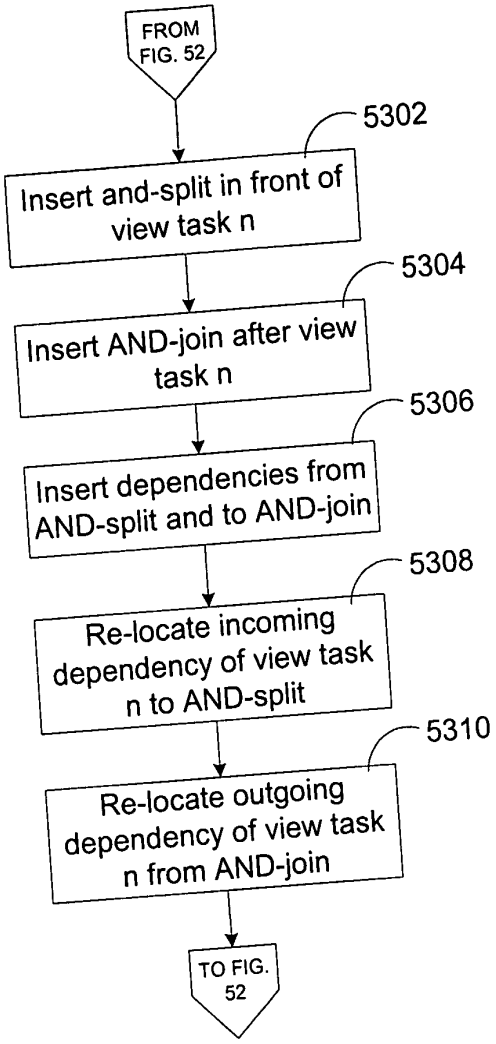

FROM FIG. 52
5300
5302
Insert and-split in front of view task n
5304
Insert AND-join after view task n
5306
Insert dependencies from AND-split and to AND-join
5308
Re-locate incoming dependency of view task n to AND-split
5310
Re-locate outgoing dependency of view task n from AND-join
TO FIG. 52

FIG. 53